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Engineering News-Record

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Sand-Clay Road Maintenance Practice in Georgia

Rio Grande River
Effect of Storage on River Erosion and Deposition
and
Channel Improvements Below El Paso

American Metal Bridges Fifty Years Ago

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FRANK C. WIGHT
Editor

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The Anthracite Miners Strike

DUE warning having been given all users of anthracite coal the strike in that industry called this week has only an academic interest to the public. Certainly no one is going to be very much concerned until cold weather sets in and even then there are few householders—and householders constitute the major users of anthracite—who have not made provision for fuel until mid-winter at least. The public therefore will not get much excited until they hear—as they have always heard in similar strikes—that some settlement has been made whereby the cost of anthracite is increased. Then there will arise a howl. The citizen's pocketbook nerve is extremely sensitive these days. He is going to object just as strenuously to paying more tribute to a muddled industry which cannot regulate its own affairs as he has already objected, with successful results, to paying too much taxes. For the present the coal user can afford to sit back and assume that all the blame for the current trouble lies with the miner but when or if the operators finally give way and then raise the price of coal the operator and the miner will be tarred with the same stick, so far as the consumer is concerned, and both will have to take the consequences of such legislation as a disgusted electorate will force their representatives to enact. This coal squabble may be a private fight, as official Washington in a dozen ways is so anxious to have the public believe, but it is going to have pretty serious public consequences if the private parties cannot settle it except at public expense.

Zoning Roads By Traffic

ANYONE touring through the country can hardly doubt that we are coming to a control of the use of certain highways much greater than now exists. Already we limit the size and weight of vehicles but the restrictions are by no means sufficient to guarantee free passage of the passenger vehicle on many of our through roads. If an airplane moving above the ordinary motor truck en route on any inter-city road of two-car width could take a continuous moving picture of that truck it would show a line of faster moving cars always behind the truck. The same cars would not be there but there would always be a queue, with the nearest car edging aside trying for a safe dart around the truck. The time lost to the automobile is very large and the increased congestion quite obvious. In our cities we are coming to a restriction of use which relegates the truck to certain streets, which in itself makes that street less attractive to the passenger car. Similar congestion on highways does not necessarily lead to the same restrictions, for remedy may be found in wider roads, where ample by-pass room is provided. But just the same, if motor trucking continues to increase at anywhere near the acceleration it has increased in the past five years passenger automobiling on some of our narrow and curved roads will become an impossibility. The remedy lies in more and wider roads, but that is expensive and it may not be possible to keep it up to the demand. There is, though, always the possibility of zoning for road use. Traffic censuses, of the complete sort which not only list existing but potential traffic, will be needed to justify such zoning, and a courageous executive will be needed to decide which is the paramount use of the road, but once ordered for some properly located road, there is little doubt that the advantages to both trucker and passenger car drivers would commend an extension of the principle.

An International Improvement

SO MUCH attention is drawn to the water problems of the Great Lakes and the St. Lawrence, at our northern boundary, that the international water questions affecting our southern boundary are largely overlooked. Yet both the Colorado and the Rio Grande involve the public weal on both sides of the line as intimately as the St. Lawrence, and the questions which they raise claim earlier answer. Joint commissions are in process of formation to deal with the water rights on these rivers. Flood troubles on the Rio Grande in the meantime call for prompt action of the two governments. Studies of the situation are presented in this issue by L. M. Lawson, the farsighted manager of the great federal reclamation project stretching north from El Paso, and S. Arroyo, who has dealt with the matter for Mexico. Just after the articles were written one of the most dangerous floods ever known came down the upper Rio Grande, in the first days of August; fortunately some data on this flood could be included by Mr. Lawson after his article was in type. The hard fighting necessary to keep the river within bounds during this flood emphasizes the urgency of channel regulation at and below El Paso. It may be hoped that arrangements can soon be made for carrying out this improvement.

Better Lien Laws

MECHANICS lien laws go far back in our legislative history. They rest on a sound basis, the desire to insure to the laborer the reward for his labor. But in most of our states they have been extended to the dealers in construction materials, and in actual operation the abuses to the law are conceivably greater than the benefits. Particularly is this true for the small owner of a home who hires a builder to put up his house, only to find out after the builder has been paid that the contract has been used to get credit from the supply houses and that he, the owner, has to pay these debts that the builder evades. It is the only field of commerce where the ultimate consumer is responsible for the cost of the raw material to the manufacturer. Not only are the laws bad but they differ in the states. This in itself is a minor evil but if there is a good standard for the law, the state should all follow it. The evil now is to

be investigated by a committee of the Department of Commerce and a uniform law recommended. If this law can provide better protection for the owner than those now in force it will be well worth the attention of the legislatures next winter.

Sand-Clay Road Upkeep

IN GOOD condition the top-soil or sand-clay road of the Southern states has few superiors in riding qualities. Its limit is a few hundred vehicles a day but within this limit maintenance is not excessive. As with all earth roads, however, the maintenance must be persistent. Virtually a continuous process of blade grading and dragging is required. Detail too is the essence of successful blading and dragging. Because it gives detail the article on the subject in this issue is important. Attention is directed to the sand-clay road section which the highway department of Georgia has made standard. The cut ditch is eliminated and all the road from bank to bank is traveled way. There is not an inch of width that cannot be dragged or bladed with no trouble whatsoever. It is not possible always of course to keep to this section. Cut ditches are often necessary and where they are the article says much that is unusual and well to know concerning maintenance methods.

How Humanize the Engineering School

CHANGE being a sign of life, one should welcome the obvious unrest in engineering education as evidence of progressive thought and action. Our engineering schools are not satisfied to remain stable; they want to move ahead to some closer approximation to what the joint thought of pedagogues and practitioners would have them. They sense defects, they entertain criticism and then they set about to correct the one and to meet the other by gropings toward new ideals or by institution of new methods. They have listened to the siren call of the "business training," and the propaganda for more "culture" has its own beguilements. And through all, the chorus of needed change runs the constant overtone "teach only the fundamentals," the stock standby of those who have only the haziest idea of what the fundamentals are or how they should be taught.

Meantime the schools are confronted with the necessity of imparting to a youth, quite immature at the start and only approaching maturity at the end, not only the principles of engineering science, but some, at least, of the detailed practice of that science so that when he goes forth to employment he will not just be able to learn how to do certain routine operations demanded of the junior engineer, but that he will actually be able to do them. This obligation has been put upon the schools by the practitioner; he demands a certain amount of engineering aptitude, he wants not an apprentice, but a junior engineer. The task of the schoolmaster, then, is to lay down this solid basis of engineering capability—a primary need—and at the same time, according to our later lights, to give the student that broader training in human affairs and that deeper appreciation of human aims and aspirations which it is freely admitted engineers, as a class, lack.

Can all this be done in four years? No one knows just how. Some of the schools are experimenting with bifurcated courses, which for the first two years wind through the pleasant paths of the school of arts and sciences with a grandstand finish of two years through some sketchy approximation to an engineering course. Such projects must, it would seem, stand or fall upon the success with which they define—and expound—the much abused "fundamentals" to the compassing of which the last two years will be devoted. Other schools have gone to five and six year courses for those who would combine the culture of the "humanities," the practicalities of business, and the dry husks of real engineering in their training to become the super-engineers of the future. Others frankly forego the hitherto required details of engineering design and construction and glorify pure—and remotely applied—science in the hope that the "fundamentally" trained graduate will be fortunate enough to be placed in early employment where he is not expected to do but merely to learn—to take, in other words, a post-graduate course at the expense of his employer.

All these things are gropings toward an attempt to humanize, as it were, the engineering graduate, to fit him to meet a changing world which needs leadership from those who proceed from fact to further fact by rational paths but which asks from its leaders some knowledge of human frailty and behavior. The rational mind, wedded to the command of natural forces, the engineer already has and with it he has advanced, much farther than he himself realizes, toward leadership, but he knows material better than he does men and he respects Mother Nature more than he does human nature. Wherefore the schools—some of them—would change his early training.

Why is it then that some of the schools have not set about trying to humanize the teaching of engineering itself, instead of substituting collateral "culture" from schools of the arts, headed by the narrowest arts men to whom the ablative absolute or the Diet of Worms or the law of diminishing returns have overwhelming importance in themselves and not as aids to life and living? Why should not the atmosphere of the engineering school be changed somewhat from that of the workshop to that of the academic grove? Is it too much to ask that a professor once in a while depart from the theory of the rigid frame to tell how an inspector threw a roughneck foreman off a job—that is if the professor ever got close enough to engineering life to know a roughneck foreman. Could not there be lectures—or better than that round table talks—once a week by some engineer or contractor who would not take up the time reading an excellent categorical account of a certain complicated design or job, but would give the boys some of the essence of his life and work? Is there anything radically wrong with a scheduling of extra-curricular reading or attendance of lectures which would not call for proof of complete mastery in final examination but which, through the medium of a key course, say, given by the broadest minded professor the school boasted, would direct the engineering burdened mind to the humanistic world which is quite outside the materialistic one he inhabits in the standard engineering course?

This, too it will be recognized, is a groping toward something not yet clearly developed. But it is a serious suggestion. The average engineering student today, as yesterday, is overwhelmed with the importance of the material thing. Engineering, so far as his instruction

goes, might be carried on without human mediation. Matter arranged in certain fashions does certain things. How it gets to be so arranged, who does the arranging, who demands that it be arranged at all and why they demand it, does not enter into the scheme of instruction. Possibly a knowledge of the way this human activity of mind and body reacts on the material world of the engineering student may be imparted by set studies of the sort some of the schools have instituted. But it is worth trying to find out if something can not be done by way of imparting an atmosphere by less adherence to the grinding toil of reports and problems and by the constant recollection of the whole instructing staff that after all what they are trying to make is an engineer—which embraces many more things than a man who can manipulate material to perform a desired function.

Liquid Capital in Garbage Disposal Plants

EXPERIENCE in hundreds of American cities shows a short average life for garbage disposal plants, with little regard to the method employed. The term "life" is not limited to the physical ability of a garbage disposal plant to do its work. It includes also the likelihood that the plant will be closed and probably never opened again due to changes in municipal administration. All this should be considered in deciding upon a method of disposal and especially in comparing yearly costs, including depreciation. It has to be considered by any disposal contractor who does not wish to face the possibility of ruin when his contract expires.

It was at least partly in recognition of this that a representative of the contractor for the disposal of the garbage of Los Angeles, Calif., stated to our editorial representative not long ago that a relatively long-time contract is necessary for anyone who agrees to dispose of a city's garbage. The wise contractor, and for that matter the wise city official, whether facing garbage disposal by a contractor or by the city direct—will give weight to this short life. Both contractors and city officials, if wise, will look with favor on the method of refuse disposal which, while being sanitary, requires the least capital investment or if not the least at the outset the one which has the largest percentage of liquid capital in the investment. Incineration and reduction plants represent no liquid capital. Each has an element of scrap value, merely. Hog-feeding plants have a large percentage of almost instantly realizable capital in the hogs, a slower but certain capital yield in the land, and as large a scrap value percentage in the remainder of the plant as pertains to the entire plant with incineration or reduction.

It would be interesting to have for comparison the amount of liquid value and scrap value found by the contractor in the Los Angeles garbage reduction plant in use for a half dozen years or so before the present hog-feeding ranch was established. Like figures for the latest garbage reduction-works at New York City, summarily shut down after a year or so of operation when Mayor Hylan came into office, would also be interesting. These are extreme cases, particularly the New York plant. A number of garbage reduction works have been operated for ten to perhaps twenty years, but when under contracts they have been subject to possible shutdowns, as a rule, after ten years at the most, and sometimes at the end of five years or less. Most of the municipally-owned reduction plants have been continued in use for ten years or more, but some of them have been in sad need of overhauling or reconstruction after short periods of operation.

Numerous incinerators have been closed after one to five years, and a large incinerator at San Francisco has stood idle ever since completed, years ago, through the action of a new city engineer who certified that the incinerator did not fulfill the contract requirements. He was unable to convince the court that he was right, so the city paid the contract price but has never used the plant. This, too, is an extreme case, but one that might have been matched at Atlanta, Ga., where a new mayor made the same sort of a refusal to accept an incinerator of the same type, contracted for by a previous administration. He also was defeated in the courts, but was unable or unwilling to keep the plant out of use once the city had paid for it.

Every engineer or contractor who has anything to do with garbage and refuse disposal contracts must face the possibilities of seeing the plant he recommends or designs or builds shut down after a short period of operation, or at least run the risk of having a legal fight on his hands to get and keep it in use. Hog-feeding plants are no exception to this risk, but as already stated, they have the advantage over the others of having a large percentage of liquid capital.

The End of the "Norman"

WRITING the last chapter of the unhappy story of the "M. E. Norman," the board of engineers of the Mississippi River Commission whose report is summarized in this issue brings to mind once more that hindsight is better than foresight. It does not say clearly whether the needful foresight should have been expected. The board refrains from assigning blame, but it sets forth the physical circumstances unmistakably. It was the boat's conversion from coal-burning to oil-burning that led to the capsizing, though nobody suspected the danger of the change. Those who ordered and those who carried out the change (the board does not name them) made a fatal blunder without being aware of it. Mississippi River steamships seem to have developed empirically and to have been taken on faith; and when operated as wood or coal burners, in accordance with original practice, they justified this faith well enough in the long run. But refitting such a boat for oil fuel changed the situation completely. As the board says, the conversion created "a great menace to safety." The vessel's stability was seriously impaired, and only a small inleakage of water—and some water was always present in the hold—would wipe out the remaining stability. The non-tight center bulkhead, violating ship-construction rules, allowed fuel-oil and water to swash about and cause the boat to wallow and in the extreme case to turn over keel upward. So the party that set out on the Cow Island Bend trip was in dire danger from the beginning, unknown to the master or to the commission officials present. To make the recurrence of such a state of affairs impossible the board properly recommends that the steamboat inspection service be called in aid. Through this recommendation and through the emphasis placed by its investigation upon structural hazards, the work of the board promises to increase the safety of river navigation materially.

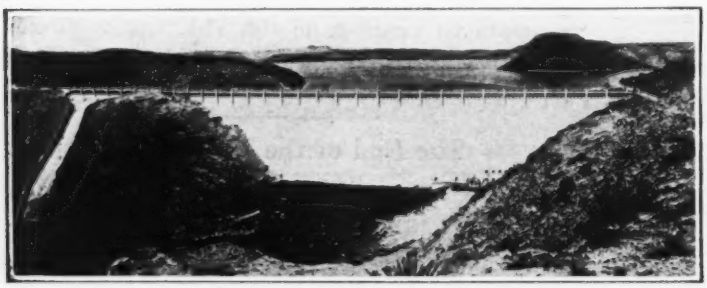
Effect of Rio Grande Storage on River Erosion and Deposition

Great Variability of Flow and High Silt Content of Uncontrolled River—Equalized Conditions—Arroyo Wash—No Change of Length or Degradation Observed

By L. M. Lawson

Project Superintendent, U. S. Bureau of Reclamation, El Paso, Texas

THE CHANGING conditions of the Rio Grande, in its course through the valleys of the Rio Grande federal irrigation project, provide an interesting contrast between the effect of the former natural fluctuating and erratic discharge and that of the flow regulated for irrigation demand by the Elephant Butte dam and its 2,600,000-acre-foot reservoir. This storage and flood-control reservoir is located in the middle section of the 1,800 miles of river between the source in Colorado and the Gulf of Mexico. In this portion of the river's course the sediment content is greatest, and its average percentage almost twice that of the Colorado River at Yuma.



Photos by L. R. Fiock

FIGS. 1 AND 2—ELEPHANT BUTTE DAM, AND HEAD OF STORAGE AT SAN MARCIAL, N. M.

Since 1897 a gaging station has been operated at San Marcial, N. M., to which point the reservoir now extends when filled to capacity. At El Paso, Tex., 195 miles below, gagings have been made for the same period. The drainage area of the Rio Grande above San Marcial is 30,000 sq.mi., and between that point and El Paso an additional 8,000 sq.mi. For the years since observations have been made the average annual flow at San Marcial has been 1,225,727 acre-feet (corresponding to 1,550 sec.-ft. continuous flow), with a maximum measured flood discharge of 33,000 sec.-ft. The silt content of the discharge at San Marcial, as determined by samplings and later by reservoir soundings, is approximately 20,000 acre-feet per annum.

The slope of the river below Elephant Butte dam varies from 4 ft. to the mile for the first 100 mi. to 3 ft. to the mile for approximately 25 mi. immediately above El Paso, and to 2 ft. per mile from El Paso south to Fabens, Tex. In each section of the valley the channel of the river is longer than the axis of the valley, the excess length increasing from approximately 20 per cent in the valleys above El Paso to 75 per cent in the lower El Paso Valley. Uncontrolled, the Rio Grande in flood periods overflowed large areas of the present project lands, depositing its sediment and changing its course avulsively and through accretion to occupy in its meanders various locations from mesa to mesa over the valley floors, varying in width from restricted canyon sections to a maximum width of six miles. Little change of length has occurred since the construction of the storage unit.

Previous to control, flood discharge distributed silt and sand sediment fairly evenly over waste and raw lands now protected from overflow and highly developed. With the introduction of cotton and its successful and high-price yield, all available land susceptible of irrigation is farmed, with the result that former pondage and flooded areas are no longer available.

The discharge from the Elephant Butte dam, regulated for irrigation demands, varies from 500 to 2,500 sec.-ft. in normal seasons. The Rio Grande is used as the main carriage canal of the project, with four diversion dams located at the heads of as many irrigation divisions in the 170-mi. length of the river through the project: The Percha diversion dam 20 mi. below Elephant Butte; the Leasburg diversion dam 60 mi., Mesilla diversion dam, 80 mi., and the International Dam at El Paso 125 mi. below Elephant Butte. The first two each raise and divert the river supply into one main canal; the remaining two supply a main canal on either end. With the demand discharge for irrigation of 2,000 sec.-ft. being released from the storage dam, the quantity flowing at various points in the project is as follows: Percha dam, 2,000; Leasburg

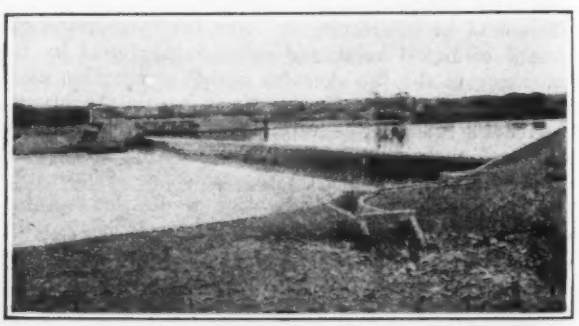


FIG. 3—PERCHA DIVERSION DAM, RIO GRANDE PROJECT 20 miles below Elephant Butte

FIG. 4—COURSE OF RIO GRANDE FROM ELEPHANT BUTTE TO EL PASO

dam, 1,650; Mesilla dam, 1,190; El Paso, 1,000; at the lower end of the project, delivered to a separate irrigation district, 140 sec.-ft.

In addition to the flow released at the storage dam, water reaches the river channel below from the discharge of the drainage system, and from arroyos which debouch into the valley, draining the 8,000 sq.mi. of territory between El Paso and Elephant Butte dam. The drainage system consists of 340 miles of open drain, by the contributions from which the water supply during the past year gained almost 300,000 acre-feet. This supply throughout the irrigation season is available for rediversion and use. The discharge from arroyos is erratic, troublesome and of no value; cutback of discharge at the storage dam cannot materially reduce the flow below in time to decrease total discharge. In October, 1916, the flow from a combination of arroyos was measured at 8,000 sec.-ft. On August 1, 1925, rains on drainage areas of several arroyos caused

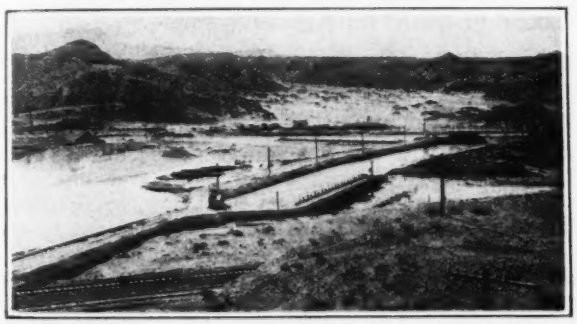


FIG. 5—INTERNATIONAL DIVERSION DAM AT EL PASO
Regulator and skimming gates

a discharge of 13,500 sec.-ft. at Percha dam and 8,400 sec.-ft. at El Paso, Texas. Large fans of eroded material from these arroyos extend into the river or valley lands, according to the topography. Where they reach the river the irrigation supply is constantly loaded with fine sand by the action of the comparatively clear water upon these sandy accumulations. The concentrated discharge from one arroyo during a local torrential rain has often equaled the combined discharge of all arroyos during a general rain. The drainage areas of these arroyos vary from a few square miles to 400 sq.mi., and are practically denuded of growth.

Previous to the construction of the storage unit, with a large percentage of sediment in the former normal flow of the river, the problem of keeping the canals and laterals open was a serious one to the detached and

TABLE I—DISCHARGES AND SEDIMENT CONTENT OF RIO GRANDE AT SAN MARCIAL (ABOVE RESERVOIR) AND AT EL PASO

(Storage in Eleplant Butte Reservoir began in 1915)

Place	—Annual Runoff, Acre-Feet— Maximum	Minimum	Mean Annual	Max. Discharge Sec.-Ft.	Mean Annual Silt Content, Acre-Feet
San Marcial, 1895–1924 incl.	2,422,008	201,000	1,225,727	33,000 (Oct. 11, 1904)	19,000 (approx.)
El Paso, 1889–1914	2,010,000	50,700	925,400	17,000 (Oct. 15, 1904)	15,300 (1906–1909 incl.)
El Paso, 1916–1925	870,418	348,951	685,232	8,400 (Aug., 1915)	480

independent communities. Practically no facilities were provided in the private or community diversions, as they existed previous to the inauguration of the Rio Grande project, for skimming or settling the large

Photo by Army Air Service

FIG. 6—ARROYO SAND DEPOSITS IN RIVER
Percha Arroyo, Palomas Valley, Rio Grande project, 20 miles below Elephant Butte dam.

amount of sand and silt which arrived at the various intakes. The removal of these accumulations by teams and scrapers represented a large part of the annual maintenance cost. Some of the finer silt was distributed on the area of irrigated lands. A large portion of the total amount carried by the normal river before it was regulated was deposited in low areas of waste and unprotected lands.

With the completion of the storage works and the assurance of water supply throughout the irrigation season the irrigated area extended, and drainage canal embankments and lateral canals constructed nearer the river channel confined the flow to a more definite location and the deposition of sediment to a limited area. The former meandering river channel became the main canal for the project. Maximum flows were reduced over fifty per cent, the mean annual flows throughout the project reduced thirty per cent, and the runoff extended throughout the length of the irrigation season of nine months, rather than concentrated in a few months in the spring or fall.

Project diversion works, as well as principal canal structures, were provided with skimming weirs and canal wasteways to the river, constructed and operated to return to the river discharge the sand sediment, and prevent large maintenance costs. As these desilt-

TABLE II—CROSS-SECTIONS OF RIO GRANDE BELOW ELEPHANT BUTTE

Areas in square feet below a given elevation; distances in miles below Elephant Butte Dam.

Date	Garfield Flume 25 miles	Detroit 50 miles	Picacho 75 miles	Mesquite 95 miles	Anthony 115 miles	Fabens 165 miles
1915 (storage began)			737	1,393	1,108	617
1918	1,528	682	858	1,095	1,095	
1919				1,371		471
1924	1,835	1,081	1,093	1,313	1,178	298
1925	1,977	917	977	1,265	....	223

ing devices were perfected and general sluicing operations became more effective, sand accumulations were concentrated in the river channel. River profiles show the effect of such deposits at diversion points and the outlets of wasteways.

Cross-sections taken of the river channel before and after construction of the storage unit are of interest in expressing the actual effect of the control and regulation of discharge on the former river channel. Table II gives the change in areas of cross-sections below a given elevation.

As may be expected, the decrease in flow at the lower end of the project, due to the consumption for irrigation purposes, has resulted in a closing in of the channel at Fabens, to one-third of its former cross-section. This same situation exists in various degrees throughout the El Paso portion of the project. Due to the absence of large destructive floods there has been no opportunity for the former scouring action, and the river channel below El Paso has filled with sand sediment to a point where it is in many places higher than the adjoining farm area. As the channel thus conforms itself to the normal irrigation flow, excess rainfall on the drainage area below the dam causes flooding of the low-lying areas adjoining the river channel. The elevation of the river channel of course is no new condition. Practically all the valley lands were formed by river deposits of silt and sand from upper drainage areas.

The situation has been under study by various agencies, and plans are now on foot to take advantage of the gradient provided by the natural slope of the valley, which is twice that of the present river slope, and confine the river discharge in the lower valley between embankments, which will permit sluicing at times of arroyo discharge or when capacity of the reservoir is reached.

Summary—The general effect of the Elephant Butte reservoir on river conditions is that the large destructive floods have been prevented; that the total amount of sediment in the lower river is a small percentage of that formerly carried; that the elevation of the lower river channel is due to the lack of proper slope and the decrease of flow; that no great degradation of the river channel is found in the upper reaches of the river and such a tendency is retarded by the existence of diversion dams and canyon sections; and that the lower river must be confined within definite limits and on a proper gradient, so that hydraulic conditions will exist in keeping with its use as a main canal and wasteway.

Channel Improvement of Rio Grande Below El Paso

Fertile Lowlands Endangered by Raising of River Bed Due to Deposition from Outwash of Small Tributaries — Rectification and Regulation of Channel Proposed for Nine-Mile Upper Section

By Salvador Arroyo
Mexican Federal Civil Engineer, Juarez, Mexico

IN RECENT years there has been a remarkable progressive rising of the bottom of the Rio Grande in front of Juarez (Mexico) and El Paso (Texas), which causes the river to become a menace to the cities and to the irrigation development along both banks of the river. The Juarez and El Paso valleys are the lower section of the Rio Grande valley between Elephant Butte and Fort Quitman mountains. The cities of Juarez and El Paso, located at the head of these valleys, are just below the pass in the mountains, El Paso del Norte, through which the Rio Grande flows over the International dam, the last of the four diversion dams across the river below the Elephant Butte storage dam to divert water for irrigation purposes to the lower irrigation division of the Rio Grande reclamation project of the United States government.

This rising of the river bottom is a consequence of the deposits of sand in the channel below El Paso, making it inadequate to carry the flood waters from several arroyos debouching into the river above. These arroyos are also the source of the sand which has been deposited below El Paso. Their flow, though erratic in time and quantity, makes possible a flood of 8,000 sec.-ft. at any time in front of Juarez. This discharge was recorded at El Paso in October, 1916, by the Bureau of Reclamation. Moreover, a general rain may cause landowners to return to the river through canal wasteways a large proportion of their irrigation supply, which return, in combination with the simultaneous flood discharge of the arroyos, may increase the total river discharge very greatly. The maximum flood flow, so produced, has been supposed to be as much as 12,000 sec.-ft. for the purpose of river-control projects. The partly filled channel below El Paso is, however, adapted only to the normal flow, being the river flow as regulated by the Elephant Butte dam and diminished by irrigation draft.

The absence of heavy destructive floods since the construction of the storage dam, the permanent irrigation supply and the drainage facilities on the American side of the river have permitted an intensive farming development of many lowlands lying on the major channel of the river. This in turn has confined the flow on the American side to a more definite location, by the construction nearer the river of drainage canal embankments and lateral canals. On the Mexican side the flow is only confined by the old bank of the river, causing the flooding of a large percentage of lowlands which can only be reclaimed by limiting the flooding zone by means of appropriate controlling works.

Due to the rising of the river bottom, at some points relatively small increases in discharge cannot be passed. Areas now intensively cultivated are subject to flooding and to the possibility of radical river changes. The river channel is now in places several feet higher than

adjacent valley lands, as in San Elizario Island. The drainage system on the American side depends entirely on gravity for its outlet, and the rise in the river bed, lessening the available gradient, causes the drainage canals to become progressively inadequate at their lower ends and thereby reduce the extension of cultivated areas. On the Mexican side, where but few protection works have been constructed, the present meander length of the river, corresponding to the regimen of the river before the construction of the Elephant Butte dam, would make protection works excessively long, and to protect lowlands now under cotton cultivation the levees would have to be placed in an exposed location. On the Mexican side, also, drainage conditions are unfavorable because of the rise of the bed, and in fact, the river

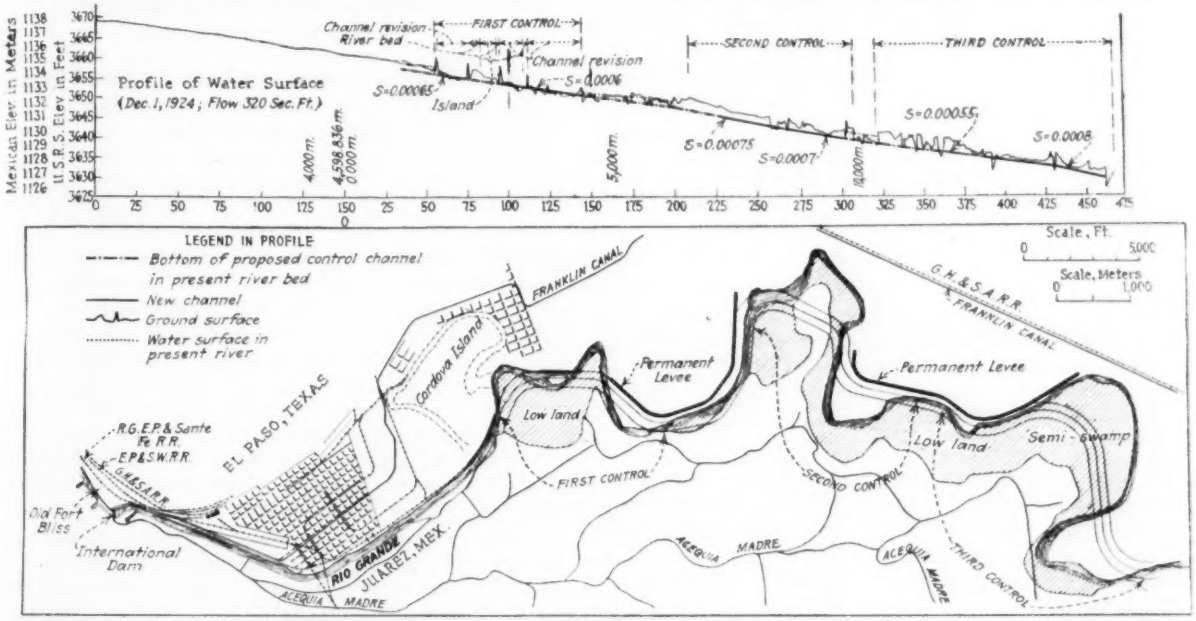


FIG. 1—PLAN AND PROFILE OF RIO GRANDE AT EL PASO AND JUAREZ, SHOWING PROPOSED IMPROVEMENT.

in several localities has become a source of supply to the underground water, with consequent increase in water-logged areas.

Summarizing, a continuance of the upbuilding of the lower river channel will result in the disestablishment of the irrigation and drainage systems already built, and the retarding of the actual development of the farming possibilities. These conditions have caused various agencies to make investigations and reports regarding the possible remedies to deal with these troubles.

Rectification of Channel—It is the unanimous opinion of all engineers who have considered the problem that a solution lies in the construction of an artificial channel as nearly straight as possible, consisting of a combination of river rectification and levee building to obtain the benefit of the natural slope of the valley, approximately 4 ft. to the mile.

The Rio Grande below El Paso is the boundary line between the United States and Mexico with the exception of two stretches, one at Cordova Island (at El Paso) and the other at San Elizario Island (below Fabens), where through artificial and avulsive changes the river left former channels, the location of which still remains the international boundary line. Any corrective plans must therefore be considered from an international standpoint and the actual accomplishment performed in a co-operative way by proper agencies in both countries.

In the opinion of L. M. Lawson and the writer, who have been studying the present river problem as engineer representatives of the American and the Mexican governments, the solution of this problem lies in introducing in the actual river regimen such conditions as will accelerate the velocity and increase its scouring action in order that a corresponding increase in the transportation capacity will occur. To accomplish this result and afford protection to lands and improvements it will be necessary to make use of a proper combination of channel shortening and suitable cross-sectioning to discharge both the maximum expected flood and the ordinary seasonal discharge. Velocities must be increased to permit carriage of additional sediment, but not to the extent of causing an uncontrollable and damaging erosive action.

A general statement of requirements for such river rectification is as follows:

1. Maximum flood discharge 12,000 sec-ft.; ordinary discharge 4,000 sec.-ft.
2. Maximum permissible velocity 5 ft. per second.
3. Cross-section of artificial channel for ordinary discharge to be 800 sq.ft., best natural width 180 ft.; channel for floods to be provided by levees or other character of construction as may be deemed convenient and necessary after exhaustive consideration of the several factors involved.
4. New locations to be confined as far as possible to areas subject to flooding, and no locations to be considered through present cultivated and improved areas. No change in nationalities of lands proposed in case of separation by river changes, but compensation to be made to landowners whose property is affected by such river changes.

As the public opinion in the cities of El Paso and Juarez has been urging the immediate adoption of some protective measures against possible heavy floods, the problem divides itself into two parts: (1) Development of a plan for complete river rectification from El

Paso to Fort Quitman, the upper and lower limits respectively of the Juarez and El Paso valleys, and (2) temporary or emergency measures to provide for the protection of lands and improvements at localities now menaced in the neighborhood of El Paso, for which work public opinion is urging immediate action.

Recommended Plan—In accordance with the general requirements as stated above, and with the view of affording some plan to give a relief from floods in the vicinity of El Paso and Juarez, where the big communities and most valuable property must be protected immediately, a general plan of nearly 9 miles of river rectification below El Paso has been prepared. In general, the plan contemplates confining the normal flow as well as expected flood within a levee system of parallel earth embankments to be constructed to provide for a channel width of 600 ft. The location has been designed not to introduce radical changes in the river's course nor propose direct cutoffs which would introduce destructive velocities. The underlying purpose of the

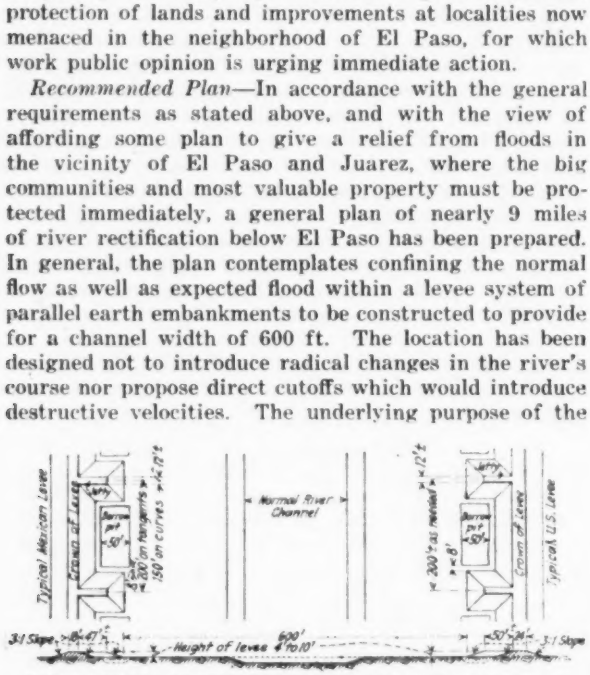


FIG. 2—CROSS-SECTION OF PROPOSED IMPROVEMENT.

Estimated mean hydraulic properties: *D*, 5 ft.; *A*, 3,000 sq.ft.; *r*, 5 ft.; *v*, 3.75 ft. per sec.; capacity of flood channel, 11,250 sec.-ft.; capacity of normal channel, 2,500 sec.-ft.; total capacity, 13,750 sec.-ft.

plan is to control within certain limits the fluctuating flow on a location which will be free from sharp, direct impingement, and pass the varying discharges through the area with limited scouring possibilities but with sufficient velocity to prevent abnormal settlement of sediment.

Concentration and confinement of the river under the proposed plan will stabilize its location, prevent further meandering, and make possible the reclamation of a large area of land in both countries now subject to overflow and seepage conditions.

The condition of 12,000-sec.-ft. flood discharge has been met by providing a width of 600 ft. between the toe slopes of the groins proposed to form a part of the levee system. The adoption of these groins, which is possible in the present regulated condition of flow, calls for concentrating on the exposed parts of the groins the revetment works which experience may show to be necessary. The inner toe of the levee and the natural foundation soil for the levee will thus be protected from erosion without continuous protection work.

The proposed control plan has been submitted for approval to the Mexican and American governments, and it is considered only as a part of the complete river rectification plan from El Paso to Fort Quitman. Control of the slope of the river is to be provided when and at such places as experience shows necessary. It is recommended also that the outlet structures in the proposed controlled channel, if any, be built of a substantial construction to prevent the possibility of the levee being washed out. Drainage outlets should be provided with flood gates. Maintenance of the levee system will include the protection of such portion or portions as experience will show to be necessary, and will also include the controlled channel area whenever it might be necessary to keep it as free as possible from weeds and brush obstruction to the normal flow of the river current.

The proposed control works, including levees, will if constructed, demonstrate that it is possible to correct the conditions actually existing along this portion of the Rio Grande in spite of the international nature of the work.

The plan described was developed by L. M. Lawson and the writer acting as a co-operative board to design and carry out the work.

Stress Repetition and Fatigue in Steel Structures

Present Experimental Data Indicate Small Risk of Fatigue—Localized Stress, Screw Threads and Corrosion

By H. F. Moore

Research Professor of Engineering Materials, University of Illinois, Urbana; In charge of Investigation of Fatigue of Metals

SINCE the classic experiments of Wöhler the danger of "fatigue" failure in machine parts has been recognized, and there has been much discussion whether there is danger of similar failure in structural members subjected to varying loads over a period of years. In some formulas for designing bridge members subjected to reversals of stress the danger of "fatigue" is recognized by designing these members to carry a load somewhat greater than that of the actual weight which is to come on them, which amounts to cutting down the working fiber stress.

Primary Stresses—Some engineers still have the feeling that the metal in a bridge member subjected to repeated stress is in some way injured. Probably this idea is in most cases a remaining trace of the idea, now thoroughly discredited, that under repeated stress steel "crystallizes." Recent investigations indicate that below a fairly well defined limiting stress steel is not injured by being subjected to repeated stress, but on the contrary is slightly improved; above this limiting stress minute cracks will form, and under a sufficient number of cycles of stress will spread like minute hacksaw cuts, and the member will fail. The metallographic microscope has given a good deal of direct evidence of the spread of such cracks. This limiting stress, below which "fatigue" will not occur in steel, has been fairly closely determined for ordinary structural steel, and has the following approximate values:

1. For cycles of complete reversals of flexural stress, one-half the tensile strength, or about 80 per cent of the yield point.

2. For cycles of completely reversed axial stress (tension-compression), one-third the tensile strength, about 50 per cent of the yield point.

3. For cycles of flexural stress varying from zero to a maximum, about three-fourths of the tensile strength, or somewhat above the yield point.

4. For cycles of axial stress varying from zero to a maximum, one-half the tensile strength, or 80 per cent of the yield point.

The yield point usually fixes the practical limit of

static strength of a structure, and it would seem that, except in the case of structural members subjected to cycles of reversed axial stress, there is little need of considering fatigue *due to the stresses which are usually computed.*

Localized Stress—It must be remembered, however, that the ordinary formulas for beams, eyebars, and columns determine only certain outstanding stresses in structural members. There are many points in structural members at which there are high localized stresses which are entirely neglected by the ordinary formulas of mechanics of materials. An illustration of such a stress is found in the stress at the edge of a rivet hole; a still more striking illustration is the stress at the root of a screw thread.

Under steady load such high localized stresses do no particular damage in structural steel. Even if they reach the yield point of the material the amount of steel affected is very small and no general distortion of the structure is noticeable. However, the case is quite different for repeated stresses, especially for stresses which are reversed. Under such stresses there is the possibility that a high localized stress may start a fatigue crack. The end of this crack is itself a point of high localized stress, and thus under successive cycles of stress the crack tends to spread to fracture. Both for machine parts and for structural parts, the most common *fatigue* failures are those resulting from some high localized stress which is *not* computed by the ordinary formulas of mechanics of materials.

Small Stress Ranges—A striking difference between the problem of fatigue in machine parts and the problem of fatigue in structural parts lies in the difference of *range* of repeated stress. Many machine parts are subjected to millions of repetitions of wide ranges of stress; comparatively few structural parts are subjected to wide ranges of repeated stress, but many structural parts are subjected to millions of repetitions of a *narrow range* of stress caused by tremors and slight vibrations in the structure, and superimposed on the static working stress already existing in the member.

Most experimental study of fatigue phenomena in metals has been made on specimens subjected to cycles of reversed stress, but a considerable amount of test data is available on specimens subjected to cycles of stress varying in magnitude but not reversed. In general, test results indicate that for structural steel there seems to be little danger of fatigue failure if the *range* of stress induced by tremors or vibration is not greater than one-half the static stress carried by the member. However, it should be noted that very few fatigue tests have been made under such small ranges of stress. Such tests involve much greater expense than reversed-stress tests. The stresses developed are well beyond the yield point of the steel, and it is necessary to use costly tension-compression testing machines in order that the magnitude of the stresses may be accurately known. Such a series of tests might, however, be expected to yield results of considerable value to the structural engineer.

Especially valuable would be experimental evidence as to the effect of such narrow ranges of repeated stress on localized stress in a structural member. Does the tendency to form a spreading crack at points of localized stress persist under such narrow ranges of repeated stresses, or does the fact that the static stress is up to the yield point at regions of localized stress tend to "iron out" the high points of stress and to make more regular the stress distribution in the member? We do not know.

In machine parts, fatigue failure usually occurs with very little warning of impending disaster, and frequently is the cause of a serious wreck to the machine. In structures, the consequences of a fatigue failure are not so likely to be disastrous. Moreover, repetition of loading takes place infrequently, and the number of repetitions of load between successive inspections is very much smaller than is the case with machines; thorough inspection can reveal a fatigue crack before it has spread so far as to cause disaster, and the part can be replaced or patched. In the case of riveted structures, the effect of repeated loading is frequently to cause merely loosening of rivets, which can be detected before a serious fatigue crack is started.

Another factor tending to mitigate the danger is the fact that structural parts are always made out of ductile steel. Ductility does not add fatigue strength to steel directly, but it does seem to have a considerable effect in retarding the start of a fatigue crack under localized stress, and in retarding the spread of a fatigue crack. A single heavy over-stress (such as might be caused by a minor railroad wreck on a bridge) does not seem to do nearly as much damage to the material as it would do to a brittle material, such as is used in springs. In the ductile material a fatigue crack does not seem likely to be started except after a good many overloads; while in the brittle material a few overloads seem to be sufficient to start a fatigue crack. Moreover, with ductile steel there is a fair chance of detecting a fatigue crack before it causes disaster.

The possibility of fatigue failure must be a major factor in the work of the machine designer. It is, in all probability, a minor factor in the work of the structural designer. However, the structural designer will always do well to minimize localized stress in every way possible.

Bolts—Bolts and nuts are in common use in machines, and are occasionally used in structures. A bolt subjected to repeated stress is extremely likely to fatigue failure without warning. The sharp groove at the root of the thread is an ideal place for high localized stress to develop, and for a fatigue crack to start. Experiences of the author with bolts on repeated-stress machines lead him to the conclusion that, for a bolt subjected to repeated stress, the value of load divided by area at root of thread should not be more than one-fourth of the safe value for static load.

Corrosion—An interesting problem, on which no test data are now available, is the influence of corrosion on the possible fatigue failure of structural steel. Corrosion pits must act as sources of high localized stress, and corrosion must produce a weakening effect greater than that indicated by the actual decrease of cross-section caused by corrosion. The accelerating effect of stress on corrosion is not known, except for high stresses—beyond the yield point. For such stresses corrosion is accelerated. Are corrosion and repeated working stress mutually accelerative destructive agencies? We do not know.

Sand-Clay Road Maintenance Practice in Georgia

Special Drainage Methods—Grassing Shoulders and Slopes—Handling Surplus Sand—Blade Grading and Dragging Practice

By H. J. Friedman

Maintenance Engineer, Savannah Division, State Highway Department, Savannah, Ga.

A LARGE portion of the 6,200-mile system of state roads in Georgia is surfaced with sand-clay. Since Jan. 1, 1922, when the state system was taken over for maintenance by the highway department, particular attention has been paid to the maintenance of this type of road. This is due not only to the large mileage but also to the fact that Georgia has pioneered in the use of sand-clay surfacing and a large section of the state has the natural material for building successful sand-clay roads. The maintenance methods here described are in general use by the Georgia highway department.

Drainage and surface are the two angles from which sand-clay road maintenance may be considered. No attempt will be made to cover the phase of conventional drainage which applies with equal force to all types of road. There are, however, a number of features of drainage that apply particularly to the sand-clay road.

Drainage—The tendency in Georgia is toward the elimination of roadbed cut ditches, except in unusual conditions. It has been found more economical to handle drainage toward cuts by the use of intercepting surface ditches. Under maintenance it is difficult to hold the cut ditch to its proper width and depth. As a result, in many cases the ditch is machined to such a depth as to be dangerous and also to take up a considerable portion of the roadbed that should serve for carrying traffic; also a great deal of time is lost by useless and indiscriminate machining of cut ditches. The newly adopted standard, Fig. 1, for a sand-clay road in cuts calls for a 30-ft. roadbed without cut ditches. The entire 30 ft. is surfaced and available to traffic, Fig. 2. The superseded standard calls for a 34-ft. roadbed, 6 ft. of which was used in the cut ditch sections, making a theoretical 28 ft. available to travel. Actually it was not usually safe to venture within a foot of the edge of the roadway adjacent to the cut ditch. The new standard, of course, calls for cut ditches where conditions of drainage, grade, etc., make them advisable.

At the ends of cuts of any length it has been a problem to prevent either erosion, under some conditions, or sanding of the roadbed under others. It is at this point that the waters carried by the cut ditches cause trouble. It has been found that by properly flaring the ditches at the ends of cuts and by diverting a portion of the water in the cut ditches before the end of the cut is reached, the problem is largely solved.

In flaring the cut ditch, the tractor and blade grader can often be used to advantage, eliminating a great deal of pick and shovel work. The construction of a flare ditch that will neither erode nor fill up with sand is not simple. It should turn off at as small an angle as possible. Where the ditch is flared abruptly the water usually breaks through the bank of the ditch and cuts a channel parallel with and adjoining the roadway. Also on a sharp angle the proper grade for drainage of the ditch is usually not secured, with the result that it rapidly chokes with sand.

In diverting water from the cut ditches, a culvert is placed across the roadway from one cut ditch to the other. To secure proper drainage in the culvert it is usually necessary to place it on a skew. The cut ditch at the upper end of the culvert is bulkheaded to divert the water through the pipe. At the lower end of the pipe a ditch is dug at a sharp angle with the roadway and usually in line with the culvert, to carry off the water from the culvert and also to divert the water from the lower cut ditch.

In the hilly country, erosion of cut ditches has caused considerable difficulty. The eroded ditch is made to fill itself to proper depth by constructing baffles, placed at proper intervals. These baffles may be simply bundles of brush placed lengthwise of the ditch with the brush end down hill. The better method is to drive a few stakes across the ditch, build a light log bulkhead behind these stakes and fill behind the bulkhead with brush and earth.

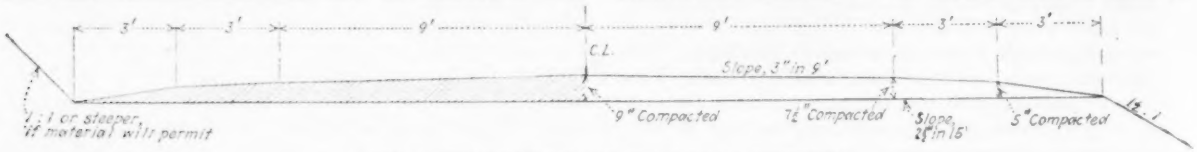


FIG. 1—STANDARD SAND-CLAY ROAD SECTION

Surfacing averages 62.03 cu.yd. per station. Basis of payment is cubic yard compacted; one-half mile free haul; overhaul 1,000 ft. units.

In a number of cases where a spring has been uncovered in a cut, tile drainage has been successful. The cut ditches are first dug to a good depth to permit proper drainage from the outlet of the tile. The tile is laid in trenches at an angle of 45 deg. with the roadway and running from the center of the road toward each ditch. A small concrete headwall is placed at each outlet to prevent scour. The number of lines of tile depends on the size and number of springs. At one location on State Route 21, Effingham County, ten lines of pipe were laid 25 ft. apart, alternating toward the opposite cut ditches. The tile was placed to give a minimum of 12-in. clearance from the subgrade. After the trench was dug a line of 1 x 8-in. plank was laid to secure an even base. On the plank a line of 4-in. tile was placed. Each of the 2-ft. joints was wrapped with burlap to prevent the entrance of sand. By use of 60-d. spikes driven in the plank, the pipe was held in alignment. The trench was backfilled with 1 ft. of selected coarse sand and the remainder with the material excavated from the ditch.

Sodding has proved the most effective method of preventing erosion of the shoulders and of slopes on fills. During March and April, the maintenance force concentrates on setting out Bermuda grass and honeysuckle. As the heaviest erosion occurs on the shoulders of the fills, two solid lines of grass are planted 12 in.

apart along each shoulder. The most effective method of securing a quick growth has been found to open up first two parallel trenches in which the grass is laid. Commercial fertilizer or manure is then sprinkled in the trenches, after which the ground is thoroughly watered. The trenches are then filled back with earth, the grass protruding a short distance above the ground. Within a month's time, a protective growth is usually well started. On the slopes the grass is planted in sprigs placed diamond shape at about 18 in. centers and forced into the earth with a pronged stick. In dry weather it is usually necessary to water the grass about once a week until it has a good start.

The unprecedented high waters of January, 1925, demonstrated the efficiency of this method of protection.

FIG. 2—TYPICAL SAND-CLAY ROAD

On Federal Aid Project 205, Tattnall County, the Altamaha River covered the roadbed for several miles. The current did considerable damage through washing of the sand-clay surface, but the shoulders which were sodded in Bermuda grass were unharmed.

At points where liability of scour makes riprap advisable, it has been found that a cover of earth planted with grass forms a mat that offers additional resistance to scour.

Surface—A difficult problem is presented where the surface is covered with sand, through material carried in the cut ditch of an intersecting road, at farm entrances, or under similar conditions. The sand can be pushed off the surface by swinging the road machine or drag to the opposite side of the road at these points, thereby pushing out the material instead of pulling it in. However, when the sand becomes heavy, this expedient does not work to advantage. It has in such cases been found economical to pull in the ditches heavily with the road machine, spreading the material from the ditches evenly over the sanded surface. This, in effect, raises the grade. New sand clay surfacing material is then placed on the new subgrade and a culvert crossing the roadbed, with an adequate take off ditch on the low side, is installed. In the event the culvert does not carry off the water and sand, the grade is again raised and resurfaced in like manner, and the process continued until the grade is high enough to prevent the sand and water from running over the surface and to admit of adequate drainage through the installed culvert.

The most difficult problem of the sand-clay road, however, lies in the removal of the sand which accumulates in the cut ditches from erosion of the slopes and the wear of the surface. There are a number of expedients—scarifying the sand into the road surface, backing it against the slopes of the cuts and cutting a ditch inside, throwing the sand in a roll out of the ditch and shoveling it to the adjacent ground. With all these methods the sand eventually finds its way back into the cut ditch, the only difference being as to the comparative cost, and the length of time for the sand to fill the ditch again.

It has been found that the only really effective method is to shovel the sand into trucks or wagons (Fig. 3) and dump it, either on the slopes of fills or at points off the roadbed. The sand is first pulled in from the ditches, using a tractor and grader (Fig. 4). The two rolls are pulled toward the center of the road until they form parallel rows with just sufficient room for a truck to pass between. The sand is loaded by shovel from this point. It is not advisable to pull up more sand than can be shoveled off in a half-day's work, as traffic, preferring the center of the road, soon knocks down the rolls if too long a stretch is prepared. Due to varying quantities of sand to be removed on account of constant changes in the character of the soil, topography, and changes from cut to fill, it would be difficult to give close costs for this class of work, or reliable figures as to progress. However, a crew of six men loading into two Ford trucks will remove a heavy sand accumulation in a cut 1,000 ft. long in a day.

It is likely that a method of sand removal using an elevating grader pulled by a tractor and loading into trucks will prove practicable. However, funds are too limited at this time to permit assembling such an outfit properly equipped; also improved projects are at present too scattered to permit the continuous operation of such a gang. Due to stumps and other obstructions, the operation of the elevating grader is not successful on any but roads that have been constructed as federal aid projects where grubbing and removal of obstructions in cut ditches is taken care of.

The blade grader with its long wheel-base and cutting edge is designed essentially to level the road surface, cutting high spots and filling depressions. After the road grader has passed over a piece of road, what might be termed the "pores" in the surface are open. The

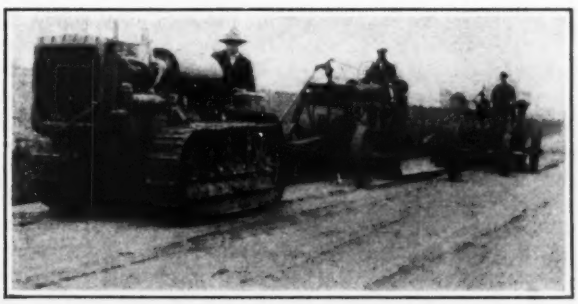


FIG. 3—TRACTOR-GRADER OUTFIT MACHINING AFTER RAIN

road drag here works to advantage on the sand-clay surface in that its smearing action tends to seal the pores in the surface.

On roads that are under heavy traffic and must be kept in the best possible shape, the surface is both machined and dragged after each rain. The road machine pulled by a tractor is first run over the surface, the blade usually being set to pull in the loose material on the shoulders and pull up the crown. This is followed by two 8-ft. drags pulled usually by a 3-ton truck. The drags are set to work back the loose material evenly

over the surface. In cases where there is too much crown in the surface, the blade grader is set to work the surface out toward the shoulders and the drags are set to pull the loose material in slightly.

On roads that are under lighter travel alternately dragging and machining after successive rains usually is satisfactory.

In cases of continued dry spells dragging the surface at not greater than ten-day intervals greatly improves its riding qualities. Dry weather and heavy traffic cause the sand-clay surface to ravel or powder. This loose material contains all the elements of the original surface. However, its presence on the surface causes dusty, uncomfortable travel. By setting the drags to work this material out, it may be spread on the shoulders where it can be pulled back onto the surface after the first rain. With the loose material worked out on the shoulder, the surface is smoother and free from dust. *Care must be taken, however, that the loose material is not worked so far out that it cannot be easily pulled in by the grader on the first rain.*

There appear to be two periods after a rain when the surface is in best condition for dragging. The first is as soon after the rain as water no longer stands on the road. At this time the surface might be called in a plastic condition. The second period is after the surface has become dry and is crumbling slightly, but when the material immediately under the surface is still damp. However, in view of the great mileage to be covered, it is the policy of the Department to commence dragging immediately after a rain and to continue until the entire surface is in satisfactory shape.

In dragging, a speed of four miles per hour on a high type sand-clay road is not excessive. On the lower types, the speed should be held down, sometimes as low as two miles per hour, as on this type of road, the function of drag encroaches on that of the grader and it is necessary that it fill large ruts and depressions.

In using the drag an experienced man should constantly ride it, making the necessary adjustments in hitch and cutting edge. The angle of hitch of the drag is of particular importance on the sand-clay road. By changing the angle at which the drags operate, the loose material on the surface may be backed out or brought in and the crown in the surface increased or decreased.

In the case of the blade grader, three miles per hour is the maximum speed as it is necessary that the operator constantly shift his cutting edge and angle of blade.

The sand-clay surface is continually changing in quality and this, together with changes in grade and topography make it essential that the blademan be experienced and alert. On steep grades, it has been found best to increase the crown in the surface so that the water will shed to the cut ditches rather than run down the center of the road and pond on the fills. However, crown should not be made so heavy that corrugations will wash into the surface and the shoulders.

On constructed projects, this superelevation has been built into the road, but the greater part of the sand-clay mileage in the state has not been constructed as projects and the question of superelevation has almost universally been neglected, often causing dangerous and difficult driving.

In machining and dragging, it is the usual practice to run down the right-hand side of the road in the direction being worked. It is advisable however, to use alternately the left- and right-hand sides. The surface is benefited, as irregularities that a machine or drag rides in and out of in constantly working on one side tend to work out when approached from the opposite direction through working alternately the right- and left-hand sides of the road. The strain and wear on the equipment are also more equalized.

The three-ton truck or the two-ton tractor have proven economical units for dragging. The two-ton

FIG. 4—TRUCKS REMOVING EXCESS SAND

tractor also handles an 8-ft. machine grader satisfactorily in working the surface. It is, of course, too light for extensive ditching work, though it can be used to advantage in cleaning out an occasional cut ditch.

The five-ton tractor is not an economical dragging unit, as there is a surplus of power. However, in machining the surface with either a 10-ft. grader or two 8-ft. graders, its work is satisfactory. It can also be used in ordinary reworking of cut ditches where the road has been put in shape with heavier equipment.

For heavy duty work such as scarifying, widening roadway, cutting ditches, etc., the 10-ton tractor with a 12-ft. blade grader is the ideal unit. On ordinary maintenance work, the lighter units are less expensive to operate and the 10-ton tractor and 12-ft. graders are now confined almost exclusively to reconstruction and heavy repair work.

Iodization at Ilkeston and Heanor, England

Iodine as a goiter preventive is being added to the water supplied by the Ilkeston and Heanor Water Board, England, states Dr. J. A. Goodfellow in an article on "Goitre and Drinking Water" (*Municipal Engineering*, London, May 14, p. 526). "Instead of making a biannual spurt," says Dr. Goodfellow, "a small amount of an iodine salt is added daily throughout the year, which I submit is the more natural way." The average daily water supply is 160 Imp m.g. or 192 U. S. m.g. The quantity of sodium iodide used is given as 2 lb. a week (i.e., for 13.44 U. S. m.g. or 1 lb. to 6.72 U. S. m.g.). "The amount needed for the day," Dr. Goodfellow says, "is weighed out and dissolved in 1 gal. of water, which is placed in a glass vessel" with a connection and control that admits "a few drops" to the water supply at each pump stroke. The narrator adds that he has "devised a method for a graduated supply by percolation through porous earthenware in reservoirs where no pump is in use." The Ilkeston and Heanor supply is the only one in England where iodization is being used, but "at Nuneaton steps have been taken in the same direction," while Chesterfield has "toyed with the idea." The population of Ilkeston was 32,269 in 1921 and of Heanor, 21,438.

Engineering in the Small City

A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000

The Editor Visits the City Engineer

Snapshots of Our Representative Small Cities

CITY AUDITORIUM, RALEIGH, N. C.

Raleigh, N. C.

STATE CAPITAL AND COUNTY SEAT OF WAKE COUNTY. Besides state buildings, is location of state agricultural college and other white and colored schools. Large cotton and tobacco market and manufacture of cotton goods, yarns, hosiery, boilers, structural iron, agricultural implements, vehicles, furniture, cottonseed oil, housebuilding material. Site was in 1782 selected for capital of state and city was laid out same year. Named for Sir Walter Raleigh. Pop. (est. 1924) 24,500.

THE CAPITAL city of North Carolina is afflicted with growing pains, and, being unused to them, to an acute degree, is at a little loss to diagnose correctly or prescribe a treatment. But some superficial diagnosis having been made and since certain therapeutics are necessary, one finds the city engineer bravely endeavoring to administer them. But his is a single-handed struggle against time-worn theories of the superior curative qualities of potions brewed from the herbs of political preferment. Unless he prevails, therefore, the city is due to suffer many a major operation in the years to come. But a belief that technical judgment may be wrong and that political administration is generally satisfactory has made the position of the city engineer a particularly difficult one. W. G. Jones was the city engineer at the time this article was written but on July 1 he resigned to become assistant city engineer of Charlotte, N. C.

Commission Government—The city government is administered by three commissioners: the mayor, who is commissioner of finance; the commissioner of public works, under whose direction are placed streets, sewers and water supply; and the commissioner of public safety, who has charge of street cleaning, garbage disposal, etc. The city engineer's office, an appointive one, is an office of the public works department. Ordinarily he supervises sewer and street design and construction. But lately the city has undertaken an extensive paving program, and has placed both the engineering design and supervision of construction with a local consulting engineer, William C. Olsen. So the city engineer has at the present time sewers as his single responsibility. But that single item is enough to keep him busy.

History—Having "just growed," like Topsy, it may be assumed that little is known of Raleigh's engineering history. For instance it is known in the office of the city engineer that there is a 12-in. sewer main leading from the state capitol to an outfall. The location of the capitol and the outfall are known, but the route the intervening pipe takes is a mystery. Now and then there is some surface indication of trouble, and what information is able to be deduced in the repair work concerning the course of the sewer is carefully noted and filed.

Also it is known that the city is fairly well sewered throughout; that is, its sanitary necessities are cared for more or less adequately. But there are few manholes to indicate the position of these sewers and there are no profiles or plans in the city engineer's office to locate them accurately. One of the first tedious tasks then is the preparation of a comprehensive sewer survey. That means not only the plans for adequate installations to meet future needs, but an actual survey of existing installations. And the manner in which such a survey was initiated and is being followed is perhaps unique in engineering history.

There is one old man in Raleigh who assisted in the laying of the old sewer lines. His memory is good but his health is not. From him there is known that there are something like 200 sewer dead-ends in the city. Their approximate location is also known. So the city engineer got this aged resident to go with him to that location. A cross ditch was dug. If the sewer line were found, a cleaning rod was run into the sewer until it could be pushed no farther. That length of sewer cleaning rod was then measured on the ground and at its end a hole was dug, the dead end found and a manhole was put in. Should this one resident die it is obvious that the job of the city engineer is greatly complicated. To get all of this information on paper at the earliest possible time Mr. Jones made a request that he be given sufficient funds to make an adequate sewer survey. The indications are that sufficient funds will be supplied at least to start the job properly. What course his successor will pursue is, of course, problematical.

Looking to the Future—As the judgment still prevails that the wish of the individual property owner and taxpayer is more essential than the corporate good the entire administration is found involved in more or less endless discussion of petty details. There is no general delegation of engineering functions to the proper authority. As a result the city engineer's time is taken up in numerous conferences over small details that he should decide alone, thus disposing of them in short time. For instance, the paving program calls for certain property line adjustments. And when paving is to be done on a street where some particularly influential citizen lives, and that citizen objects to rearrangement of his front yard to meet a uniform street width, the entire city administration goes into conference over whether the setback shall be 2 ft. or 3 ft. However, none of this adjustment to meet personal desires on the part of property owners is malicious. It is merely the desire of the city administration to meet all the wishes of the electorate, not realizing that sooner than later it should recognize the need for building for a future city of from three to five times the present population.

In the past it has often been the case that property owners have encroached on the street width as much

as 10 ft., providing they could make a logical plea before the city authorities. As late as this spring a property owner was allowed 6 ft. more depth to his lot than he should have been given. And this tendency, also, the city engineer tries to refute with the argument that while other cities of like size are taking off part of lot frontages to widen narrow thoroughfares, the city of Raleigh is continuing to move in the opposite direction—toward further congestion.

Another improvement for which the city engineer is bending his every effort is toward proper disposal of sewage. Now sewers discharge into various small waterways or depressions with inadequate primary treatment with septic tanks. His superiors believe that the city can get along as it has done, despite the growing community. But the city engineer knows that sooner or later the state board of health will insist on proper disposal. Any new installations are therefore being planned for the future, though the means for securing adequacy of service are unique. When a new lateral is to be laid the city engineer has found it advantageous to prescribe a pipe 50 per cent larger in capacity than will be needed; because he has found that if he specifies an 18-in. pipe, for instance, the commission will usually cut him down to a 12-in. pipe, which size will be adequate. The lay belief exists that an 8-in. pipe running full is more economical than a larger size partially filled with no provision for emergencies.

In the development of new residence sections there is no harmonizing of water and sewer services with the general layout. Installations are usually put in to meet the needs of that particular new development, and with increased density of population pavements must be cut for larger services. There is scarcely a block of paving in the entire city that has not been cut into either for the examination and repair of existing services or the installation of new ones.

The staff of the city engineer is also entirely inadequate. The city engineer and one rodman compose the entire city engineering staff. The water department, however, has its own engineering service, though E. B. Bain, the superintendent, has little assistance. The water-works is municipally owned. The city has an adequate supply, and a comparatively new and modern filtration plant. So water supply is simply operation.

Paving—Like so many North Carolina cities, Raleigh is in the midst of an extensive paving program. It is quite probable that the coming of good highways throughout the state has considerably quickened street paving. The general population of the state, and most of it in small cities, having become accustomed to good highways, has been quite willing to pay most of the cost of street improvement. Abutting property therefore pays for the cost of paving in Raleigh, and the city pays for curbs and gutters and intersections making the division of cost about 25 per cent for the city and 75 per cent for the property owner. The type of pavement being laid is almost exclusively a modified topeka on a concrete base. The city has engaged consulting engineering design and supervision and has done more than $1,000,000 worth of work in the last twelve months. The present program calls for a like amount during the coming year. As the city still deems it unnecessary to provide for storm water, valley gutters prevail in the construction of the new paving. Though the topography of the city is not flat, sooner or later a storm sewer system must be installed, which will mean extensive revision of the new paving.

Raleigh is not unique in its lack of an engineering consciousness. There are other cities in the South equally indifferent to broad programs of engineering development. The city engineers may be partially to blame. Too great insistence that they are right and the opposition wrong means they must look for other employment. But concerted action and co-operation among a large body of such city officers could be a strong argument in favor of engineering by engineers and for the general municipal good.

Engineering Work

How One City Protects Its Valuable Ocean Front Property

EVERY seaside municipality will have a continuing engineering problem as a result of its proximity to the sea, a problem created by the tide, winds, storms, and the disintegrating action of salt water. Santa Monica, Calif., has such a problem, and it is twofold: first, to preserve the beach itself; and second, to preserve the works upon it.

The municipal pier, originally of reinforced concrete, was constructed in 1910. Ten years later it was found necessary to remove the concrete piling and replace it with timber. The cumulative shock and stress due to wave action and the porous condition of the concrete, which permitted sea water to penetrate to the reinforcing, with consequent rust and expansion, caused the piling to fail.

To make the repairs, holes were opened in the concrete deck adjacent to the old bents, and new wooden piling was driven through the holes. Then they were capped with timber. The concrete deck during the action of blasting the old concrete piling out was held in place by girders from the last bent driven to the next concrete bent to be removed. At the completion of one new bent the girders were extended to the next. The pier is now sound, and is used to carry the outfall sewer. It is a decided asset because of its popularity as a fishing pier. Some direct revenue is secured from concessions and licenses which permit the landing of fishing boats. The pier is about to be extended. It will be widened at the outer end with timber construction to accommodate the docking of passenger boats.

The wide stretch of sand which extends in front of Santa Monica forms one of the finest beaches in the state, and as many tourists are attracted by it, as well as inland residents who come for the bathing and coolness, it is of tremendous value as a revenue producer. At this point the waves come in strongly from the northwest, except in the period of severe storms—the winter—when the wind shifts to the southwest. Wind and sea from these quarters are destructive, as they tend to gouge out the beach.

A form of shore protection inaugurated by private property owners are two groins which project into the sea from the northwestern part of the city. These are about 400 ft. in length each, and are 2,500 ft. apart. They are of timber sheetpiling, 12 ft. above high tide,

Of the Small City

and are tied with outrigging pile. The falsework for the use of the piledriver was made permanent and this acts as outrigging. These groins have been in place since 1922. They have built up the beach between them and to the north to a width of an additional 70 ft. for a shoreline distance of 4,000 ft. The disadvantage of such groins is that, whereas they build up the beach on one side they cut it away on the other. The groins are therefore a source of litigation, with property owners whose beach frontage has been damaged, the aggressors. Facing such a condition, City Engineer Howard B. Carter has devised a staggered pier construction, rather than one with uniform bents. This gives free access of water, retards the sediment, and allows free passage to bathers. Aerial observation shows that with staggered construction a series of small crescents is formed instead of one large one.

Mr. Carter has prepared plans for ten piers of the new type, to be built 1,000 ft. apart and 300 ft. long. They will be 50 ft. wide on top, with a T crossbar at the outer end. They will be built either of piling or concrete construction, and will be equipped with fishing facilities, comfort stations and other conveniences. They will also furnish parking room for hundreds of automobiles.

Mr. Carter has recommended to the city council that this work be undertaken as soon as possible. It is favorably regarded not only from the standpoint of beach preservation, since erosion would be checked and the beach built up, but because of its non-engineering advantages. The piers will cost about $10,000 each by the present estimate.

Street Cleaning Costs in Cincinnati

COMPARATIVE costs of street cleaning in Cincinnati are given for the past four years in the 1924 annual report of Fred Maag, superintendent of the street cleaning department. He states that the work is at a minimum. The depletion of the department has continued, live-stock is dying off without replenishment and wagons and horses show proportionate deterioration. In 1914 503 employees were on the roll and 290 head of live-stock in the stables. Now there are 211 men and 157 head of stock. Certain functions were motorized in 1920 at a cost of $85,000. The following table gives unit costs:

	1921		1922		1923		1924	
		With Overhead		With Overhead		With Overhead		With Overhead
Horse flushing per square	$12.4	$26.2	$20.1	$33.6	$16.9	$40.9	$17.5	$29.0
Auto flushing per square	2.2	5.0	2.2	5.6	2.0	5.1	2.6	4.9
Street sweepings per cu.yd.	50.2	89.4	43.7	78.3	49.5	89.0	48.3	85.8
Ash collection	47.6	78.8	41.3	70.5	43.7	75.8	45.3	74.5
White wings per 1,000 sq.yd.	43.4	49.6	36.4	43.1	23.5	28.6	23.2	27.8
Broom gang per square	32.5	37.7	25.5	30.8	30.1	37.2	31.2	37.7
Gutters per square	25.0	27.9	19.6	22.5	24.4	29.1	22.3	26.2
Tractor ash haul, per cu.yd.					38.5	76.6	43.2	70.5
Tractor mud haul, per cu.yd.					37.8	72.4	46.3	82.6

*1Square = 16,000 sq.ft.

Labor for hand cleaning of 553 catch basins (1,230 cu.yd.) cost $4.16 each, varying by months from $2.09 in February to $6.72 in September. Cleaning basins by auto was started in May and for labor averaged $3.43 each for the 158 basins cleaned (515 cu.yd.). The variation was from $2.08 in May to $5.33 in December. Overhead brought the total cost up to $6.55 and $6.70 respectively for hand and auto cleaning.

Convenient Cabinet for the Small Engineering Office

A PLACE to put field books, blueprints and particularly blank forms where they will be conveniently accessible without disturbing other records or supplies, is the requirement of almost every small engineering office or branch office. E. C. Evans, office engineer at Pocatello, for the Idaho department of public works, bureau of highways, solved this problem effectively by designing and having a local planing mill build the cabinet shown in the accompanying illustration. The cost was $115 and the cabinet has been highly satisfactory.

The over-all height is 7 ft. 1 in., the length, 9 ft. 2 in. The lower portion or cabinet proper consists of a tier of drawers on the right and on the left shelf space partitioned off in 8x8-in. pigeonholes for rolls of blueprints. The drawers are 7 in. deep; the blueprint space is

CABINET FOR SUPPLIES, BLUEPRINTS AND FIELD BOOKS

behind a pair of doors whose panels are made of 3-ply veneer, $\frac{3}{8}$ in. thick.

For convenience in moving, the shelf-unit above the cabinet proper is made independent of the lower part to which it is fastened only by a pair of heavy screws at each end. The pigeonholes are 9 in. wide by 8 in. high, the latter dimension being enough to take the standard field book of which this office keeps a large number (in top row) for reference.

Perhaps the most convenient part of the cabinet is the ample number of roomy pigeonholes in the shelf unit at a convenient height for blank forms. With this system, any of the various blanks issued from this office can be picked up without either opening a drawer or fingering through a file. The broad "table top" on the cabinet proper and in front of the shelf section is a convenient place to spread out blueprints or check over records.

The cabinet is made of pine on which a walnut stain was used. Partitions are of $\frac{1}{2}$-in. material with heavier wood in sides and frame. To keep the weight down to a minimum the end panels, like the panels of the doors in the lower section are of 3-ply veneer and likewise the bottoms of the drawers are made of Beaverboard.

Laying Out Track Plan of Large Passenger Terminal

St. Paul Union Station Affords Example of Design of Track Layout—Surveys, Plans and Complicated Field Work

IN the design and construction of large railroad terminals, the planning of the track system and the laying out of the system in the field are features of great importance. An example of work of this kind is the track plan of the new Union Station at St. Paul, Minn., which station was described in *Engineering News-Record* of Jan. 31, 1924, p. 186 and comprises fourteen through tracks and eight stub tracks in the station, besides two freight tracks. At the east end the twenty-two station tracks converge into a seven-track approach ending in a Y-connection with a north and south main line at right angles to the station. At the west end the sixteen through tracks converge on a four-track approach.

General Plan—In designing the track plan of the station, with its station yard and approaches, the number of station tracks was determined from careful consideration of past and possible future traffic developments. Of the five principal entrances two are used exclusively as through tracks, and it was considered necessary to provide double-track movement through the yard to only the other three entrances. To provide against possible interference by derailments, there are crossovers, pocket tracks and auxiliary leads so arranged as to furnish alternative routes and prevent blocking of the yard.

After the general plan had been prepared, a definite time study was made on the basis of the train schedule or time-table then in operation. Track occupancy diagrams were then prepared and a careful study was made of the series of switching movements required with each train. The general plan was drawn on a scale of 50 ft. to the inch, and was afterward enlarged to 20 ft. to the inch for reference and field work.

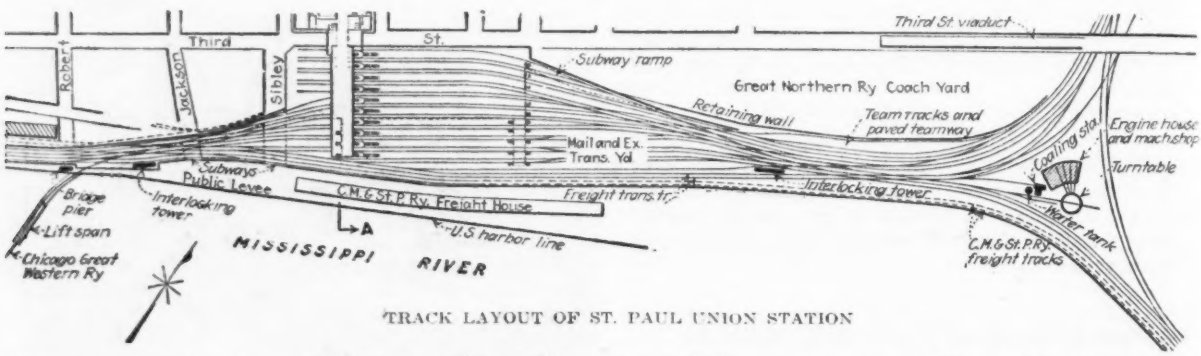
Surveys and Plans—In laying out the track system on the ground, the entire work was based on cartesian co-ordinates. Before any field work had been done, the axes were established in the office and from these a precise survey was made of the right-of-way lines. Every angle was measured at least five times. A standard tape was used and all measurements were made between tacks driven into wooden stakes. Temperature readings were taken every hour and the elevation of the top of every stake was determined. From these data, calculations were made, with corrections for temperature and grade, and the co-ordinates of every point were calculated.

In laying out the track work the equation was calculated for every tangent line and the co-ordinates of every point of curve, point of intersection and point of tangent. For switches, there were calculated the co-ordinates of intersection of center line of main track with center line of track at frog produced. No attempt was made to write the equations of curves, as these equations would be of second power and very cumbersome, with large figures. Seven-place logarithms were used in all calculations in order to avoid the effect of cumulative errors. The co-ordinates of all points were carried out to six significant figures. Most of the work lies in the fourth quadrant; none in the second quadrant.

It is considered that no other method could compare with the co-ordinate system for such a complicated layout. Every feature was definitely and permanently located. This system has been found of considerable value in designing intricate layouts, because in some cases it has been found, in calculating, that a layout feasible on the drawing table is not practicable in the field.

Field Work Methods—No difficulty was experienced in laying out and checking the location of switches, slip switches, crossovers and other special features as laid down on the plan. For staking turnouts, stakes were set for the heel and toe of the frog on both tracks, working usually from the point of intersection of the two center line tangents through the frog. For the standard turnout with No. 8 frog, having a ½-in. frog point, the distance from this point of intersection to the actual toe of the frog measured along either tangent is 38 ft. If the two track tangents intersected at a standard frog angle, no stakes were set in the turnout side of the switch, except the heel and toe stakes mentioned, the proper curve being given the turnout side of the switch by measurements from the gage line of the main track. Where the switch was introduced on a curved main line, or in case it was necessary to introduce curvature outside the switch on the turnout track, both tracks were made tangent through the frog.

For slip switches, in addition to heel and toe stakes at the frogs, a stake was set at the intersection of both center lines and also at the end of the knuckle rail or heel of end points to facilitate lining up the knuckle rails, which are the first parts of the slip laid in place. Since all the joints of the slip switch are numbered and stamped in the shop, as is also the case with crossings, it was an easy matter to assemble the various parts of the switch and connect them properly. Prints showing details of the slip switches on a scale of ¾ in. to the foot were given to the foreman, but after having in-



TRACK LAYOUT OF ST. PAUL UNION STATION

stalled one or two slips the print, as a rule, was used only in checking up the tie spacing. There are several crossings in combination with double-slip switches and turnouts, but the placing of these gave no special trouble as they are largely standardized.

The greatest difficulty was at the Y-connection with the north and south main line at the east end of the station yard, in which there are numerous turnouts and several crossovers. These crossovers occur in curved tracks, so that they tended to complicate matters, since it was necessary to locate switches so as to give the required clearance as well as maintain the curvature in the tracks and through the crossover.

Several base lines were established in connection with the track work; some parallel with the *X*-axis and others parallel with the *Y*-axis. As the equation of the center line of the track is known, and as an added check on the location of the track, its intercepts could be readily computed and set off on the desired base lines. This furnished a very certain check on locations made. The whole system is dependent, of course, upon the accuracy of the original surveys made when the plans of this development were first started.

The original surveys and the designs of the track plan were made under the direction of the late W. C. Armstrong, who was chief engineer from March, 1915, until his death in June, 1923. The field layout has been under the direction of Col. Frederick Mears, chief engineer, until May, 1925; G. H. Wilsey, now chief engineer and formerly principal assistant engineer, and W. B. May, principal assistant engineer and formerly assistant engineer.

American Metal Bridges Fifty Years Ago

The Turning Point in Designing Practice—Influences for Improvement—Elimination of Cast-Iron Members

By Carl Gayler
Consulting Engineer, St. Louis, Mo.

As a contribution to the history of engineering fifty years ago which is being brought out in *Engineering News-Record*, the writer wishes to demonstrate the fact that about that time, beginning in the seventies, a new era began in American bridge design.

This new era was brought about not because the time of wooden structures under the competition of metal bridges was drawing to an end—for this process had already begun in the middle of the century—but mainly through the fact that the designing of bridges was taken out of the hands of competing bridge companies and turned over to trained engineers, who, unhampered by the laws of competition, could do their work on correct, scientific principles.

Should the reader expect the following to be written in the charming style of Clemens Herschel's contribution of May 17 he will be disappointed; however, he may find some facts stated and some deductions drawn from them which will interest him.

Development Before 1875—We look back with admiration to the wooden structures which from the very beginning of the last century were built across our streams, built too by carpenters or mechanics, men without any technical training or scientific education, who were guided only by their genius and their experience with the materials employed. The comparatively short life of the wooden bridge, the rise and growing influence of the bridge shop and rolling mill, and, above all, the extension of the net of railroads pressed the wooden bridge to the wall and the iron bridge took its place.

These pre-1875 metal structures are now merely of historic interest, but to the man who has distinct recollections of their construction they are still worth recalling to memory, although, as Mr. Herschel suggests, to have to look back over half a century in order to recall these times is not an unalloyed pleasure. These bridges are now all gone and records of their details are scanty, but we know the limitations under which the designers had to work, and with this knowledge on hand we can understand why they have been so quickly and thoroughly superseded by more worthy structures after our assumed turning point had been reached. Let us briefly consider them, confining ourselves to truss bridges.

Bridge Characteristics of That Period—The trusses were all pin-connected, with long panels, the type that, on the whole, has remained unaltered to the present day. Thanks to the master mind of Squire Whipple the method of ascertaining the stresses in their main members was known.

The materials used for the chords and posts was cast or wrought iron. The great compressive resistance of small cast-iron specimens was the stock argument of the bidder in advocating the use of the former material for these members. The different shapes of wrought-iron compression members, which still required at the joints cast-iron blocks, were soon covered by patents obtained by powerful bridge companies—the old Keystone Bridge Co., Baltimore Bridge Co. and others. In fact all important bridge building of that period was subject to bitter competitive fights between these leading companies.

Extravagant claims were made for the strength of these compressive members, and who was to gainsay them at a time when no full-size tests had as yet been made and column formulas such as had filtered in from Europe were but tentative; when the factor of safety was based not on the elastic limit but on the breaking strength of the specimen; when the term "modulus of elasticity" was unknown and the testing machine had not yet come into general use?

Tensile members were either adjustable rods or eyebars with forged heads.

Pins and Rivets—The history of the diameter of pins is curious. Proportioned only for the shear stress, they were soon found to become loose or to bend, so that the arbitrary ruling was adopted that the diameter of the pin should be not less than ⅞ (later on increased to 1) of the width of the connecting eyebars. Nobody dreamed of investigating the effects of bending moments in pins.

The rivet was looked upon merely as an excellent contrivance for rigidly pressing plates and angles together, and with this object in view the maximum spacing was generally limited to 6 in. That the pitch of rivets in a riveted girder is determined by the laws of shear was not known. The use of field rivets was reduced to a minimum, bolts or hangers taking their place. This at least proved of decided advantage by reducing the time required for erection.

Floors were, as a rule, carried directly by the chords

with no additional material allowed for overcoming the resulting bending moments.

St. Charles Bridge—As a characteristic example of this type of bridge, we may select the St. Charles bridge over the Missouri River, of which the writer has a distinct recollection. It was a single-track bridge on the main line of the old North Missouri (now Wabash) railroad, with four or five spans 350 ft. long and long trestles at each end.

The top chords were cast-iron tubes of polygonal cross-section, jointed in the simplest possible manner, the ends of the tubes butting against each other and a circular flange of one of the ends reaching into the inside of the next tube, somewhat like joints in water or gas pipes. The end posts were of wrought iron. The intermediate posts were round columns, butting against the top chord and pin-connected to the bottom chord. The bottom chords consisted of eyebars which carried the ends of the railroad ties.

There is in one of the cemeteries of the city of St. Charles a small monument erected in 1871 to the memory of the 18 men who were killed when one of the spans fell under a passing train. This monument, shown by photographs herewith, is of peculiar interest as it consists of one end of one of the top chords and of an intermediate post which had both been fished out of the bottom of the river. The relative position which the two castings held in the trusses was changed when the monument was erected.

MONUMENT TO FATAL WRECK OF CAST-IRON BRIDGE

From the crashing down of a second span a few years later dates the final exclusion of cast-iron members from American bridge work.

We can most decidedly not "look back with admiration" to this period as was stated in regard to the preceding period. We had become surpassed by European engineers in the art of metal bridge building and could boast of no works comparable to the Kulemburg bridge in Holland or the Rhine bridge at Coblenz.

The New Era—But a new era was at hand. In 1874 the Eads Bridge at St. Louis was completed and shortly after Roebling's East River Bridge. That these two monumental structures would have a great and lasting influence on all bridge work in this country was to be expected. For the first time in American bridge building careful study and planning preceded the execution of the work, and by the use of testing machines accurate knowledge was gained of the materials which it was intended to use—most of them materials which had never been used before. The bold and ingenious manner of erecting the Eads bridge foreshadowed on a large scale the future cantilever bridge, and the computation of the stresses in its members under moving loads and changing temperature was a decided step forward over the mathematical investigations hitherto attempted.

And such works could not be carried out without reflecting high credit on the engineers engaged in them. The thoroughly commercialized period of bridge lettings and bridge building came now to an end and the work of the structural or as he was soon after called the bridge engineer, came to be recognized and appreciated.

Specifications for Design—One great advance in this direction we owe to the engineers who were employed by the board of trustees under whose direction the Cincinnati Southern Ry. was being built. This road opened the South to the city of Cincinnati. It led through a mountainous country and several large bridges were required. Here for the first time all bridge work was let on a sound basis by means of a carefully prepared set of specifications to which all bidders had to conform.

The specifications included qualities of the material subject to test at the mills, and rules based on sound mathematical calculations for obtaining sizes and proportions of the different details. Patented compression members, rules of thumb for pins or for rivet spacings, etc., disappeared.

This method of making specifications, or if so desired specifications and plans, the basis of all lettings, either by railroad companies, municipalities, states or counties, has ever since those days become more and more the general rule. It insures equal chances to all bidders without being a bar to their inventiveness or greater experience.

Shortly after the completion of the Eads and Roebling bridges followed the building of the high cantilever bridge over the Kentucky River and of several long-span bridges over the Ohio River.

From our assumed turning point of 50 years ago in American bridge building a steady, unbroken progress in its character can be recorded.

Mileage of Surfaced Roads Exceeds 450,000

Although the exact state of road improvement in the United States at the present time is not known, it is estimated by the Department of Agriculture that the total mileage of surfaced roads at the end of 1924 was between 450,000 and 475,000 miles. Indications are that approximately 40,000 miles of surfaced roads of various types have been built during each year since 1921. Exact figures as to how this mileage has been divided by types or states are not available. A considerable part of the work, moreover, has consisted of resurfacing. It therefore can not be assumed that the net mileage of surfaced roads has been increased during the last three years by the total amount of the new construction. The last complete survey of the road improvement situation was made in 1921 when the total surfaced mileage was reckoned at 387,760 miles. New construction and resurfacing since 1921 have proceeded at a rate which is believed to justify the estimate that the net gain since then is well above 60,000 miles.

Board Reports on Capsizing of Steamer "M. E. Norman"

Overloading, Water in the Hold, and Faulty Transverse Bulkheading Found Responsible for Disaster

REPORTING after full investigation into the sinking of the Mississippi River steamer "M. E. Norman" near Memphis, Tenn., on May 8, 1925, with the loss of 23 lives, a board of army engineers attributes the disaster to the presence of water in the hold and defective arrangement of the bulkheading in the hull, which permitted water and oil to swash from side to side. The freeboard of the boat on its fatal trip was so low, that the decks were frequently awash during the trip, and this low freeboard contributed to making the capsizing possible.

As reported fully in *Engineering News-Record* of May 8, pp. 827 and 829, and May 21, p. 855, the "Norman," a towboat of the Mississippi River Commission, was carrying a convention of mid-south engineers on a trip of inspection of revetment work at Cow Island Bend, some 20 miles below Memphis. It capsized on the return trip. Its companion steamer "Choctaw" reached Memphis safely.

Immediately after the accident the president of the Mississippi River Commission appointed an investigating board composed of Maj. H. H. Stickney, Jr., district engineer; Capt. Edward M. Chisolm, Jr., secretary, Mississippi River Commission; A. Miller Todd, assistant engineer; W. S. Mitchell, assistant engineer, and F. H. Hilliard, assistant engineer, all of the Mississippi River Commission organization. This board has been engaged since then in collecting evidence and studying the facts of the accident. The facts brought together in its report are briefly noted below, following which the board's conclusions are quoted substantially in full.

Construction of Steamer—The "Norman" was built in 1924 for a lumber company, but early in 1925 was bought by the Mississippi River Commission for towing and inspection service of the commission's first and second districts at Memphis. It was designed by Capt. John R. Drackett and built by the Hogan Boiler Co., Morgan City, La. It was a steel-hull vessel with wooden superstructure, of the normal type of small stern-wheel Mississippi River towboats, and was 115 ft. in length, 26 ft. in breadth and 4 ft. in molded depth amidships. The ratio of length to breadth was rather smaller, and therefore more favorable to stability, than the 5:1 ratio found in many other river boats. On the main deck were mounted three boilers and the two engines driving the stern wheel. The general superstructure arrangement is suggested by the sketches in Fig. 1.

The hull was framed with 8-in. channel ribs spaced 20 in. on centers, steel shell and deck (bottom ¼-in. steel), and three longitudinal members. The full-length center longitudinal keelson bulkhead consisted of a plate web with angle stiffeners and double top and bottom bounding angles. It extended only between the deck beams and the floorbeams, except in the two oil compartments. Here the spaces between floorbeams were stopped with intercostal plates formed by extensions to or by notching of the bulkhead web plate for passing the beams, these extension plates being attached to the deck and bottom plating by angle clips. Thus, in the dry holds there was ample connection between the two sides or compartments of the hold in the spaces between frames, while in the oil holds there was passage between the side compartments only through the bosom spaces of the beams and a few other small leakage spaces. However, in addition the center bulkhead in each of the two oil holds contained a diamond-shaped manhole opening 18 in. wide by 15 in. high, about 18 in. above the hull bottom. Shutter plates were to have been provided for these openings, but the after hold at least was never fitted with such a plate.

The builders constructed the vessel with these oil holds and in other manner prepared it for oil burning, but finally equipped it for coal burning. The Mississippi River Commission on purchasing the boat bought with it part of the burner equipment bought by the original owners, and converted the vessel into an oil burner. While this change involved only minor change

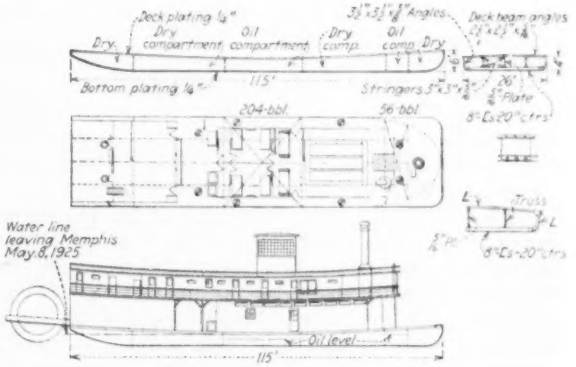


FIG. 1—DECK AND HULL ARRANGEMENT OF STEAMER "M. E. NORMAN" AT TIME OF SINKING, MAY 8, 1925

in the amount of dead weight or in the position of center of gravity, the board points out its dangerous feature: "The oil, as it was carried in the holds, lowered the center of gravity of the craft and tended to increase its stability; but this desirable feature was nullified and changed to a great menace to safety through the faulty construction of the center bulkhead in the oil holds." During the trip of the vessel from Morgan City to Memphis after it purchase (Jan. 20 to Feb. 3, 1925), apparently before its conversion to oil-burning, "the boat acted remarkably well in all respects, and was exceptionally steady and free from eccentric movement while under way."

For the trip of May 8, 60 extra life preservers and 2 extra skiffs were added to the equipment of the vessel. The vessel appears to have had an unusually large supply of fuel at the time, in preparation for a long service tour. However, inspection of the boat just before the day's trip, covering the condition of the hull, the amount of fuel, and other items of condition and safety, during which also the steam siphons in the several holds were operated, showed nothing unusual or dangerous.

The board notes that in the structure of the vessel there were various points, detailed in the report, where small amounts of water could leak into the holds from the deck (as around the feed pump piping) and through the sides (by leakage along the bolts holding the 4x8 oak rubbing strake). This presumably explains the

possible presence of water in the holds during the fatal trip. There appears to be no direct evidence on the presence or amount of such water except the inspection before starting. However the steam siphons were so arranged that "none of them fully cleared their holds, leaving about 3 in. depth of bilge water after operation." This amounted to about 11 tons, or nearly 2 in. draft. The board concludes that at least 11 tons and possibly twice this amount of water was present in the holds.

The oil holds were large enough to take 550 bbl. or 90 tons of oil, but only 400 bbl. or 65 tons could be carried without draft of the boat to about the bottom of the nosing. The amount of oil carried on the day of the accident is not definitely known, but the total displacement of the vessel was about 244 tons.

The Fatal Trip—In the trip to Cow Island Bend with the party of engineers on May 8, the "Norman" started from Memphis shortly after 12 noon and reached its destination, 21 miles downstream, about 2:30 p.m. "Statements show that on the trip down the steamer was slowed down more than once on account of the wash over the head and low sides." It started on the return trip about 3:30, following behind the steamer "Choctaw." On the return trip 65 passengers, or 15 more than on the trip down, were on the "Norman," making, with the crew, a total of 75. When abreast Hog Pond light, about 4 o'clock, the vessel seemed to have taken a decided list to starboard (near point *A* in Fig. 2), and the master, assuming that most of the passengers were sitting on the shady side of the boat, sent word asking them to distribute evenly. Subsequently, the board concludes, the steamer came up practically to level trim, proceeded for 25 or 30 min. to point *B* in Fig. 2, then listed again to starboard, then to port, and finally to starboard, continuing to roll in practically one continuous movement until bottomside up (at point *C*). The total time from *B* to *C* is estimated at 15 min. and the time required for the final capsizing movement about 2 min.; this occurred at 4:45 p.m. Thereafter the steamer partially righted, coming up until the port edge of the hull and part of the cabin showed above water, then turned back until again bottomside up, and floating in this position gradually sank stern first, until final submergence. Forty-seven passengers and 5 of the crew were saved, and 18 passengers and 5 of the crew were lost. Six of the dead have not been recovered.

Cause of the Accident—Discussing the facts of the construction of the boat and the events preceding the accident, the board says:

> The testimony before the Board seems conclusive that the "Norman" in general design, in disposition of weights, including coal, and in behavior after purchase was a stable and safe craft up to the time of the change of fuel and fuel burning installation, exhibiting no tendency to crankiness or unseaworthiness in operation beyond that of river vessels of its proportions and class. Nor is there evidence given that at any time during its occasional services in the short period of oil burning prior to the trip on May 8 was eccentric behavior noticed.
>
> The total added weight due to alterations and extra equipment after purchase tended to raise the center of gravity of the craft, but removal of coal fuel from the deck and bunkering oil fuel in the hold lowered the center of gravity in greater degree, tending to increase stability.
>
> The combined weight of all passengers and crew was so small (about 5 tons) as to be negligible, being less than that of any bunker of coal.
>
> The conditions of river and weather during the trip were not abnormal in any degree.
>
> From the foregoing, therefore, it must be inferred that the cause of the accident lay within the boat itself by reason of unusual conditions imposed on the day of the accident, and the development thereby of dangerous details of construction.
>
> The boat had taken on a very heavy fueling in order to accomplish a considerable tour of service immediately after the inspection trip, and this so reduced freeboard—with only casual observation of the fact by all those in charge of loading or operation—as afterward to increase greatly the dangerous condition of the vessel.
>
> The evidence seems conclusive, too, that inspection of the vessel's holds prior to and during the trip was lax and perfunctory. None of those in charge of such matters were able to give convincing testimony as to water in the holds, which must have been present in very dangerous quantity, not now definitely determinable, but not less than 11 tons and probably double that quantity, depending on highly probable leakages during this trip and on the quantity of oil on board. The latter had been rudely gaged but definite record of the quantity on board was probably lost with the boat. However, from the lines of the hull, as reproduced by the naval architect, and the displacement computed therefrom, the quantities of liquid cargo were determined with reasonable approximation (49 tons), and proved sufficient to have caused the overturning under the conditions of service on the day in question.
>
> With such large quantities of liquids in the holds the faulty character of the center longitudinal keelson bulkhead quickly developed.
>
> Under the slightest natural and usual roll of the vessel under way the water passed rapidly and without obstruction between the floorbeams under the bulkhead from one side of the hull to the other, and thereby induced similar though slower, because of viscosity, flow of oil, through its smaller (but still large aggregate) passages, until the accumulated weight of oil kept both oil and water on the same side, the eccentric weight increasing steadily until the righting moment of the vessel was gone, when the slightest added external force of wind or wave or current, or all, overbalanced that moment, and the boat capsized.
>
> The foregoing seem to have been the direct and inherent causes of this deplorable accident, which, however, might still have been avoided but for several indirect and highly contributory causes.
>
> At the time of purchase and thereafter the dangerous openings under the center bulkhead went unnoticed or were ignored, although the construction was similar to—and probably was followed by the designers and builders of—that of wooden vessels in which a non-tight bulkhead is recognized as a stiffener only and the open spaces thereunder as contributing to great danger with any large quantity of water in the hold, and all concerned in the several inspections of the "Norman" were thoroughly familiar with such facts, through long association with wooden river craft. The open manhole in the aft oil bunker was recognized and commented upon by them as dangerous, but the many small openings at the floor—with aggregate orifice even greater than the manhole, and located directly in any flow of the oil—were not appreciated probably because of the small size of each opening, and due to its being partially obscured by the adjacent stopper plate between floorbeams. The danger inherent to full beam space openings in the other holds also seems to have been ignored.
>
> In connection with this bulkhead construction the original builders, by inference, also may be subject to criticism since they withheld information concerning the oil bunkering, which was freely discussed, and have stated—after the accident—that they did not complete the oil installation for which the "Norman" was designed, because of the disquieting behavior of a similar vessel under their operation with oil fuel bunkered in similar holds. It is probable the builders did not recognize the cause of their own trouble.
>
> Prior to and on the day of the trip inspections of the boat were made by officials of the district supply and repair depot and by the licensed officers of the vessel, in preparation for the large number of guests expected on board. These inspections and preparations seem to have consisted mainly in looking after appliances for the safety and comfort of the passengers, but for the vessel seem rather to have been cursory rounds of a boat thought to be in all respects in good order. The siphons are said to have been operated to exhaustion point of water in the holds, but the

latter were not examined further to determine ingress of water other than from condensation. The hatches throughout the waist of the boat, however, were battened and bolted down anticipating unusual shipping of water over the low sides and head of the "Norman" when so deeply laden and running free. Yet when from repeated careenings it began to be suspected by a number on board—including officials of the district—that the holds might be deep in water, removal of the hatches for examination was demurred to and deprecated by the officer of the boat on the lower deck because of the danger of taking water from the deck which was continually awash, but stopping or landing the boat for examination was not suggested. This was afterward suggested by the District Engineer, grown uneasy by the behavior of the boat, but that action came too late and the boat was lost while attempting to land.

The arrangement for crew for the occasion proved inadequate. The master and pilot of the boat was unable to act as master by engrossing duty as pilot, and only learned imperfectly, and from time to time, the conditions on the

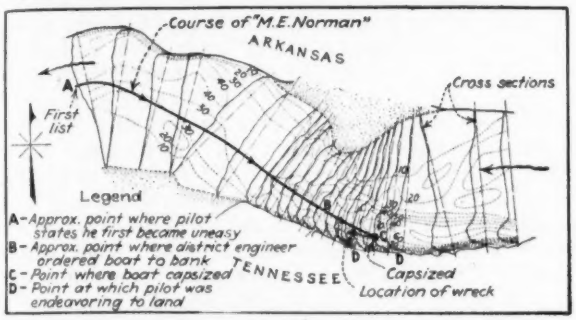

Course of "M.E.Norman"
ARKANSAS
Cross sections
First list
Legend
A- Approx. point where pilot states he first became uneasy
B- Approx. point where district engineer ordered boat to bank
C- Point where boat capsized
D- Point at which pilot was endeavoring to land
TENNESSEE
Capsized
Location of wreck

FIG. 2—MISSISSIPPI RIVER AT POINT OF SINKING OF "NORMAN"

lower deck through reports from others, some of whom, through inexperience with such craft, did not recognize fully the great danger indicated by the extreme careening and wallowing of the boat on the upstream trip. The master and pilot also seems not to have appreciated, from such reports, the gravity of the situation, and probably, at the last, with too great deference to a general, and veiled, instruction "to land the boat," from his higher district officials whom he knew to be inexperienced and not very accustomed to the operation of boats, followed literally the instruction and indication of landing place across the deepest and swiftest water in the vicinity, in which the boat sank. It is inconceivable that one who had had so many years of experience on passenger vessels would have followed that dangerous course rather than attempt beaching the boat on the shallow Arkansas side, had he been so clearly informed of conditions as to have been fully alive to the danger that threatened. Under the circumstances of confusion and bustle incident to a crowd on board on such a trip, a licensed and experienced officer, master or mate, in full charge of the lower deck, probably would have recognized, reported and acted authoritatively, as could not be done by the head deckhand.

The many indirect influences above recited are considered contributory to the disaster.

From the foregoing statement of causes, it may be seen in general how and among whom responsibility for the accident may be divided. It involves nearly all district officials and employees directly connected with the boat and its operations from the time of the purchase inspections till the day of the disaster. Therefore fixation of responsibility in appropriate degree upon individuals cannot now be done. Some to whose judgment the district looked confidently for more meticulous oversight of the vessel and its operations were among the lost, partly victims of their own inadvertence or reliance upon others below them. Custom of the district shares indirectly through a generally commendable restriction of crews upon small vessels, which relegated, on this extraordinary service of the boat, its highest officer to a subordinate though still important position, the duties of which wholly prevented exercise of his highest function while the boat was under way, and the district did not adequately furnish the supervisory service which the event proved to have been imperatively demanded, which demand that officer recognized—though somewhat feebly—by attempting to perform the service with such aid as could be had from one of the very subordinate members of his crew.

Recommendations—The board recommends that both the Mississippi River Commission and the Engineer Department of the Army submit their vessels annually to authoritative inspection by the U. S. Steamboat Inspection Service, which is not now done except at the time of construction or purchase. It also recommends that the stability of river vessels of the two organizations be examined by analysis, that maximum safe loadings be therefrom determined, and that marks similar to Plimsoll marks be affixed to the sides of the vessels to mark the deepest allowable draft, that where calculations show doubtful stability careening tests be made, and that special report be made on all considerable alterations in weight.

Giving special consideration to the question whether the wreck of the "Norman" should be raised, the board recommends against such raising. It does not consider that any useful information on the cause of the accident can be developed by raising the wreck, and that therefore the expense of the operation is not warranted.

Combined Water Softening, Turbidity and Iron-Removal Plant

Abstract of paper read before the Illinois Section of the American Water Works Association by C. S. Timanus, Burns & McDonnell Engineering Co.

AS THE well-and-gallery system of the Springfield (Ill.) water-works is nearing the economical limit of development the new iron removal, water softening and filtration plant is designed to handle both well water and Sangamon River water. The well water shows 280 to 300 p.p.m. hardness and contains 2 p.p.m. of iron. The river water is somewhat softer than the well water but it is turbid and poor in sanitary quality.

As the temporary or carbonate hardness is 85 per cent of the total hardness it was decided to use (1) lime treatment which will also bring down the iron, (2) carbonation after the reaction is within 90 to 95 per cent complete and (3) filtration. Coagulation in tanks of 40-min. detention, where paddles revolve at 1¼ r.p.m., will effect 80 to 90 per cent of the softening, depending on the temperature.

Two clarifiers 63 ft. square and 15 ft. deep, giving a detention period of 1.7 hours, will remove 90 per cent of the settleable solids. The mechanism will be supported on a concrete arch. Provision is made to waste the sludge or return it to the coagulation basin to utilize the unspent lime. Two settling basins giving 3.8 hours detention will compensate for unequal dosage or change in effectiveness of chemicals due to change in temperature.

The two carbonation chambers receiving the water skimmed from the settling basin outlets are so baffled as to give the water a slow velocity for 140 ft. over a submerged grid discharging CO_2. When the water reaches the carbonation chambers, under the most favorable conditions, only about 90 to 95 per cent of the softening reaction has been completed. The carbon dioxide will be introduced to reverse this reaction and prevent its going to completion on the filter beds. Carbon dioxide will be supplied from a small gas generating plant, equipped with a small gas-producer burning coke. The gas will be passed through a scrubber and forced to the carbonation chamber by means of a motor-operated blower. The capacity of the generator will be 3,500 lb. of CO_2 gas per day.

Eight 1.5-m.g.d. filters having 3-in. perforated-pipe underdrains discharge into a 2-m.g. clear well loaded with 8 ft. of earth on the heavy floor slab and roof to resist the buoyant effect of ground water during high-water stages.

Directly under each of the three lime storage bins is a 1,000-lb. hopper scale, fitted with a revolving bucket which will discharge 2 lb. of lime per revolution into the slaking tank discharging into solution tanks from which the milk of lime solution is raised to lime feeders over the dosing well.

Wisconsin Supreme Court Enjoins Stream Pollution

Mitchell Realty Co. and City of Milwaukee Win Suit and City of West Allis Must Pay Celery Land Owner $50,000

REPORTED BY WILLIAM R. COPELAND
Witness for the Plaintiffs and Chief Chemist, Sewerage Commission of Milwaukee

ON June 5, 1924, the Supreme Court of Wisconsin awarded a riparian owner $50,000 damages for the flooding of his celery farm together with the creation of a public nuisance in the waters of Honey Creek by raw and partially treated sewage discharged into the stream by the city of West Allis, and ordered the city to abate the nuisance within 60 days. The decision of the supreme court was on an appeal from the Circuit Court of Milwaukee County. The main point in the decision of the supreme court is the time-honored rule, based on the common law of America and England, that no municipality, corporation, or individual has the right to pollute or alter the waters of a natural stream to the detriment of a riparian owner.

Issues of Case—Points distinguishing this case from others where there have been similar rulings are:

(1) That this was a case in equity involving the rights of the public as well as of a private citizen, and therefore that the defendant city of West Allis can be held liable for all of the damages, even though part may have been caused by industrial concerns lying outside of the city limits and further downstream.

(2) That rights of the public were involved because obnoxious odors were created by the fermentation of organic matter of sewage origin deposited in the stream by city sewers, and that these odors rising from the stream interfered with the enjoyment of parks located along the creek.

(3) That waters from "foreign sources"—in this case Lake Michigan and artesian wells—used as a municipal water supply and discharged into Honey Creek through storm overflow sewers and the outlet pipe from the West Allis sewage-works—caused the farm lands of the Mitchell Realty Co. to be excessively overflowed.

(4) That these flood waters caused the lands to become "water-logged" to the detriment of crops for which the soil was well adapted, crops being raised there abundantly in previous years.

(5) That although the city of West Allis had installed sewage-works which removed as much as 60 per cent of the organic impurities this removal was not sufficient to meet the requirements existing under the natural flow of water in Honey Creek.

(6) That whereas the defendant city was liable for all of the damages, it had under the law a right to collect in its turn sums of money from the other contributing sewage producers along the stream proportional to the damage which the Circuit Court should find that they had caused in the stream.

Facts and Conditions—West Allis, a city of over 10,000 people, is situated on the headwaters of Honey Creek. This is a small stream which in former years often ran dry in summer, but since West Allis has been pouring the effluent from its sewers and sewage-works into the river the stream never runs dry and often overflows its banks. The waters are further augmented by wastes from seven industrial plants located along the banks of the creek below West Allis but above the farm lands of the Mitchell Realty Co. and the public parks of the city of Milwaukee.

Organic matter, carried by the sewage and plant effluents, after entering the stream ferments, with the production of oxygen-absorbing compounds which exhaust the oxygen carried by the natural river water, produce foul odors, and charge the waters with immense numbers of sewage bacteria. These conditions are dangerous to the public health, prevent the public from enjoying the free use of the parks abutting on the stream, and keep the lands so saturated with water that nothing but coarse weeds will grow there. The reason for the development of such a condition is that when the soil becomes water-logged air cannot penetrate to the roots of the plants and so only marsh plants grow. The soil was naturally a rich black loam, eminently well adapted to the raising of garden vegetables, such as celery, and for many years the neighboring farmers grew large crops of celery over an area of a hundred acres immediately contiguous to the stream. West Allis constructed the first part of its sewerage system about 1900, and in 1907 built a cameron septic tank and contact beds on the banks of Honey Creek a short distance above where these celery fields exist. Soon afterward complaints began to arise against the odors which develop in the stream in summer and the State Board of Health was asked to intervene. The board sent its inspectors to investigate the situation, collect samples of the stream water for analysis and to report upon the most desirable remedial measures. Analyses showed that the stream was a public nuisance, principally because it was overtaxed by the wastes from West Allis, and as a result the city was requested to enlarge its sewage-works. In 1914 another septic tank was added and the contact beds were overhauled, but the nuisance continued. Therefore in 1918 the septic tanks were converted into Imhoff tanks.

After flowing by the West Allis sewage-works and factories Honey Creek passes the Mitchell property and Jackson Park—a public playground developed many years ago by Milwaukee. Further downstream the creek runs through a settled part of the city and passes a second public park. In former years as many as 15,000 people have been known to picnic in these parks on a single day but in recent times the foul odors rising from the creek have prevented people from congregating there.

Contentions of the Plaintiffs—The plaintiffs argued that prior to the founding of West Allis and the construction of the sewers discharging into Honey Creek from the town and from the disposal works, the river waters were clean and suitable for fishing, bathing, and stock watering, but that since the construction of these works the waters have become filthy, germ laden, and charged with grease and other deleterious matters to such an extent that riparian owners below cannot use the waters for normal purposes. The odors rising from the stream are so obnoxious that tenants of the Mitchell Realty Co. occupying houses on the banks of the stream have abandoned the dwellings with the result that the company has lost a considerable revenue which it formerly enjoyed. West Allis, finding itself short of water for its citizens, has purchased many millions of

gallons of water from Milwaukee, directed various industries in the town to connect their waste waters, consisting in some instances of water pumped out of artesian wells, into the storm sewers leading to the creek, and diverted through a sewer part of the storm water run off from a neighboring watershed into Honey Creek. The discharge of these waters raises the level of the water in the stream to a point where it overflows its banks more often and to a much greater degree than the waters normal to the stream have done in previous years. For that reason, the Mitchell Co. was obligated to build drains at great expense, and when the drains became inadequate to handle the flow truck gardeners refused to rent the land. This caused the plaintiffs a direct loss of income amounting to $50,000, and put the land into such an unfertile condition that three years of constant liming and draining would be required to restore the land to normal productivity. Finally the plaintiffs held that the sewage of West Allis was only partially purified and so contaminated the stream. For that reason and because the suit was a matter of equity they held that the city was responsible for all of the damages.

Contentions of the Defense—The main defense of the city of West Allis was based upon the theory of comparative convenience. The gist of their argument was that the city after incorporating and encouraging people and industries to come there to locate was in duty bound to provide sewers, sewage disposal, water supply, and drainage, and that as Honey Creek was the natural outlet for the runoff of storm water from this area lower riparian owners had no relief at law. The defendant claimed that the septic tanks, contact beds, etc., were installed by and with the consent of the State Board of Health, that analyses showed that the plant removed from 55 to 60 per cent of the impurities, which was a higher degree of purification than is obtained by similar plants elsewhere, and that the wastes contributed by the seven industries below were heavily charged with organic and other impurities at the time they entered the river. They laid particular stress upon the fact that these wastes in some cases carried great quantities of salts of iron in a ferrous condition which would and did consume quantities of oxygen. For these and other reasons the defendant claimed that West Allis could not be held liable for all of the damages.

Ruling of the Supreme Court—The supreme court overruled the appeal of the defendant and awarded $50,000 damages to the plaintiffs. Further, the court declared that West Allis created a public nuisance in Honey Creek by discharging partly treated sewage into the stream and therefore ordered the city to abate the nuisance within 60 days.

In denying the appeal of the defendant, the court cited the case of *Winchell vs. Waukesha, Wisconsin*, 110, 101, 107. That Court held (April 9, 1901):

> The right of the riparian owner to the natural flow of water—substantially unimpaired in volume and purity—is one of great value and one which the law nowhere has more persistently recognized and jealously protected than in Wisconsin. . . . Amid this conflict of important rights we can not believe that the Legislature concealed in words merely authorizing municipalities to raise and expend money for the construction of sewers a declaration of policy that each municipality might, in its discretion, take practical possession of the nearest stream as a vehicle for the transportation of its sewage in crude and deleterious condition. . . . The great weight of authority, American and English, supports the view that legislative authority to install a sewer system carries no implication of authority to create or maintain a nuisance, and it matters not whether such nuisance results from negligence or from the plan adopted.
>
> The effluent coming from the West Allis sewage disposal plant consisted largely of partly digested sewage, chemicals, and other refuse which were deposited upon the plaintiff's land by the aforesaid overflows. . . . That such overflows have resulted in packing the soil of the plaintiff's lands and so saturating them with moisture and impurities as to cause them to become unproductive. . . . That because of these conditions many acres of the property formerly highly productive for the raising of celery have ceased to have a rental value. . . . That the volumes of water discharged by the defendant corporations contained polluting materials and vegetable matters which greatly added to the pollution of the streams.
>
> The suit of The Mitchell Realty Co. and city of Milwaukee vs. West Allis was a suit in equity brought under section 3181 Wisconsin Statutes, Chapt. 190, laws of 1882. Therefore West Allis may be held for the whole damage under the law. The case of *Valparaiso vs. Moffitt*, 12 Ind. App. 250,54 Am. St.Rep. 525. is in point. The case made by the plaintiffs in this action is that of a public nuisance and all persons who created or contributed are jointly and severally liable for all the damage resulting therefrom. . . .
>
> Also *West Muncie Strawboard Co. vs. Slack*, 164 Ind. 21, 72 N.E. 879—A distinction is recognized between such acts which are wrongful only because injurious to individual rights and those which combine and constitute a public nuisance. . . . In the former class of cases each separate wrongdoer is chargeable with his own acts alone. . . . In the latter case each may be answerable in a joint and several action, not only for what he himself does but likewise for the acts of those who, with him, violate public as well as private rights. If a party deliberately places himself in opposition to the entire community by performing an act which . . . violates an express statute and creates a public nuisance. . . . He must have anticipated the natural and probable consequences of the acts, namely the violation of the public right, and the public interest requires he shall . . . bear the full burden of the wrong he insisted in implicating.

Comment by the Writer—In the prosecution of the original case of Mitchell vs. West Allis an immense amount of testimony was taken. The court seemed, however, to focus upon three main features. (1) That a municipality, although consisting of many thousands of individuals, does not have the right to pollute a natural watercourse to the detriment of lower riparian owners. (2) That if it becomes necessary for a municipality or corporation to make use of a natural watercourse to carry away its sewage the public right demands that the sewage must be purified, at no matter what cost to the producer, to a degree such that it will cause no injury to lower riparian rights. (3) That when the public interest becomes involved the matter resolves itself into a question of equity primarily although damages may be brought in as an adjunct. Decisions of this sort point clearly to the necessity in the future of educating municipalities to provide adequate sewage purification in order to protect them against the assessment of expensive damages.

State Road Bonds

About four-tenths of the bonded debt of the states of the United States has been incurred for highway construction. The exact figures as given by the Bank of America, New York City, are $626,852,350. The total state bonded debt for all purposes is $1,558,742,433. The proportion of road bonds is 40.2 per cent.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

300-Ton Pier Shed Moved 170 Ft. with Barge Derricks

THE RECENT moving of a portion of the shed on one of the piers of the Clyde Steamship Co. in the Hudson River, New York City, was effected by the use of barge derricks. The estimated weight of the section moved, which was a two-story column and plate girder structure covered with corrugated sheet metal, was 300 tons. This section was 75x118 ft. in plan and the steelwork was divided into five bays. It was moved 170 ft.

The moving of the shed was a part of a major construction plan to cover the outer 200 ft. of the pier. Since it was necessary to provide a two-story structure

MOVING 300-TON BUILDING WITH DERRICK BARGES

at this outer end (the upper story being used for offices), it was decided to move the office section of the existing pier shed and fill in the resulting open section with a new one-story structure.

Four self-propelled barge derricks of 250, 125, 90 and 60-ton capacity respectively were used in the moving operation. The drop lines of the derrick booms were fastened to 14 slings attached symmetrically both at the intersection of the columns with the roof trusses and to the heavy plate girders forming the second story floor system. The building was lifted evenly from its foundation by the use of wedges under the column bases as each derrick assumed its share of the load. The building was lifted about 18 in. It was carried to its new foundations at the end of the pier by means of the derrick boats moving under their own power along the side of the pier. The moving of the shed had to be done in the very early morning so that the derrick boats would not roll under the waves caused by river traffic. A patrol boat was stationed about 200 yd. out in the river to keep any early morning traffic at a sufficient distance to prevent its swell from reaching the barges. The entire operation after the section was cut loose from the old pier shed took about 2 hours.

Identical procedure was used on an adjacent pier, but in this case the moved section weighed only 50 tons and was 71x22 ft. in plan. Eight slings were used. Tilt-Hargan Co., New York, was general contractor on the job. The sub-contractor, Merritt-Chapman & Scott Corp., New York, did the actual moving of the sheds and will erect the steel for the new section.

Airtight Joint and Plunger Safeguard Gas Main Crossing Lift-Span Bridge

THE carrying of a 22-in. gas main across a 1,000-ft. bridge in Portland, Oregon, presented a number of knotty engineering problems, which were solved by Blood & Williams, consulting engineers, Portland. The bridge has a vertical lift span which frequently is raised 90 ft. above its normal level. As the bridge is used by railroad trains, automobiles and pedestrians, the pipe line had to be installed in such a manner that there should be absolutely no danger to the public, from leakage or other causes. The installation was made for the Portland Gas & Coke Co. on the bridge owned by the Union Pacific Railway Co.

The pipe line is connected to the west side mains near the bridge abutment, and is supported on the bottom chord of the fixed span just below the railroad level. At the east and west ends of the lift span a vertical pipe is carried up the tower posts, and plungers 100 ft. in length operate inside this pipe. These are connected on top to a horizontal pipe attached to the top chord of the lift span. This enables gas to flow freely through the pipe whether the lift span is in its normal position or raised for passage of river traffic.

From the east end of the lift span the pipe extends along the lower chord of the fixed span up to the east end abutment. It then passes underneath the railroad deck along the abutment to the south side, thence through the abutment, where connection is made to the east side mains. The horizontal portion of the pipe line has a walkway for its full length, and the vertical portion has ladders, enabling every part of the line to be inspected at any time. Expansion joints in the pipes correspond to expansion joints in the bridge.

Drip-pots are also fitted at various points on the line to collect any foreign matter which might be passing through with the gas. Pipe lines extending from these drip-pots to the walkway on the bridge permit this foreign matter to be drawn off at will. At both the east and the west abutments of the bridge there is a valve attached to the line, making it possible to turn the gas off at either or both ends.

The plunger is 13¾ in. in diameter outside, and the casing is 14 in. in diameter inside. The plunger is made up in five lengths, machined on the outside, with the joints of various sections made by means of an internal splice held in place by threads, the stress on the plungers being carried by tightly driven pins. Inasmuch as these plungers extend vertically at times to 90 ft., without any lateral support, it was necessary to make splices that would keep them perfectly aligned and maintain a tight joint.

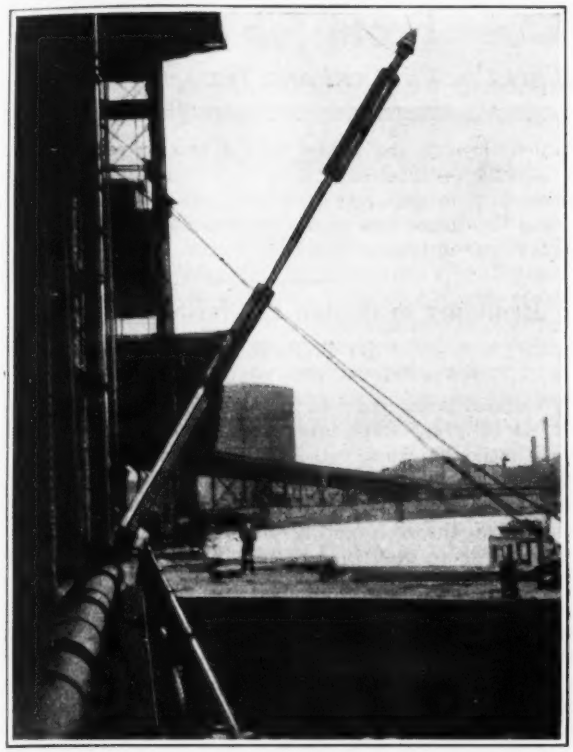


FIG. 1—PLUNGER WITH FLEXIBLE JOINT CONNECTIONS

In leaving the casing these plungers pass through a triple-sealed gas tight joint. The upper and lower parts of this joint are fitted with glands packed with asbestos and metallic packing. Between the glands is a space entirely filled with oil. About 8 ft. above this joint there is attached to the bridge an oil container of 12 gal. capacity, the lower part of which is connected to the triple-sealed joint, with the upper part attached to the gas main. This balances the pressure above and below the lower joint, as far as the gas is concerned, and adds to the upper part of the joint a pressure equal to the head of oil. This not only seals the joint, but also keeps the plunger constantly lubricated. The container referred to above is fitted with a glass gage to enable attendants to ascertain its contents at any time. This container can be shut off from the gas main at any time by means of valves.

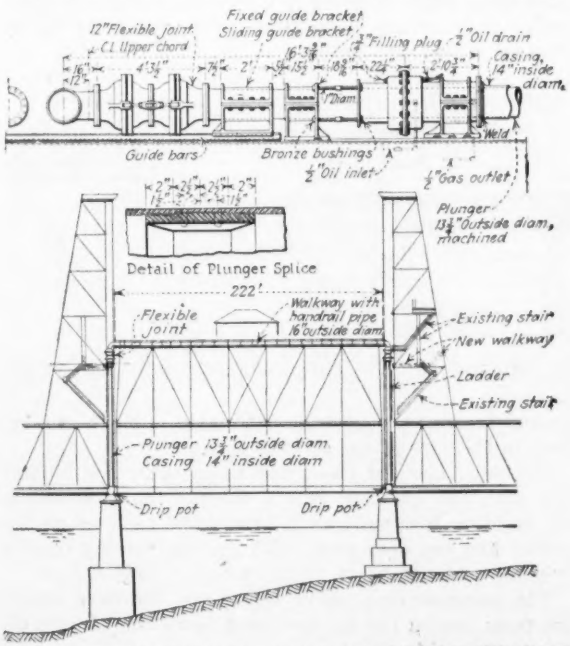


FIG. 2—DETAILS OF PLUNGER AND ITS INSTALLATION

The vertical towers of the bridge, which carry the sheaves for the operation of the vertical lift, lean in an east and west direction when the lift is in its normal position, but when the lift is in operation these towers pull over towards each other. To take care of this variation it was necessary to install a double ball-joint at the top of the plungers. The tops of the plungers themselves are fitted with a bracket which slides on guide angles riveted to the towers. Above the ball-joints there is a cast-steel elbow connecting to the pipe which extends across the top chord of the lift span. This elbow takes all the pull and thrust due to the operation of the ram. The rams themselves were fitted up completely at the shop of the Willamette Iron and Steel Co. in 100-ft. lengths, and transported from their plant to the bridge on barges in horizontal position and supported on saddles. They were then lifted off the barge and revolved in midair from a horizontal to a vertical position without losing alignment. After being lifted to the top of the towers they were lowered through their brackets into place in the casing. The weight of each plunger is about 10,000 lb.

Due to the casing pipe's extending into the roadway from the side of the bridge, it was necessary to change the steelwork on the upper deck, and to make an offset in the roadway to maintain the same clearance as before. Although most of the construction was carried out while traffic was moving in its normal volume, the work caused little inconvenience to the public.

Irrigation Tunnel Constructed in Earth and Hard Clay

A 6,500-FT. irrigation tunnel which has been built on the North Platte reclamation project to carry water from the Fort Laramie Canal to the Gering Valley, through a high brule-clay ridge, was selected as the most economical plan, since a shorter tunnel on another location would have involved carrying the main canal through eight miles of bad lands crossed by dry ravines 30 to 60 ft. deep. The tunnel, near Mitchell, Neb., is of horseshoe section, 10 ft. 3 in. high, with a 10-in. concrete lining and canal approaches lined with reinforced-concrete. Plans were made at the Denver office of the U. S. Bureau of Reclamation, and the contract was let to R. S. Morrow & Son, Omaha, Neb., the cement and reinforcing steel being furnished by the Bureau. The following description of the construction work is abstracted from an article in the official *New Reclamation Era* by J. K. Rohrer, resident engineer.

About 1,390 ft. at the north end and 1,100 ft. at the south end are in earth, the remainder is in hard clay. Timbering was required throughout. In earth, five-piece frames of 6x8-in. timbers were used, with vertical posts, 6x6-in. longitudinal sills and 6x8-in. cross sills; these frames, 4 ft. c. to c., were completely lagged with 3-in. boards. In brule clay, seven-piece frames were used, with sloping posts and no cross sills; they were 8 ft. c. to c. and lagged half way down to spring line.

Excavation to the full section was worked from both ends; in earth it was kept 4 ft. ahead of the timbering and lagging, while in clay it was about 50 ft. ahead. Material was loaded by hand into cars pulled by mules to the portal, whence a cable hoist hauled them up an incline to the dump. When brule clay was reached and blasting became necessary, the material was loaded into the cars by a shovel-loader driven by compressed air supplied from a compressor near the portal. Holes for the blasts were bored with coal augers operated by air-driven breast drills. For ventilation, a 30-in. motor-driven blower drew out the gas from near the breast through a 6-in. pipe led through one of the test pits or one of the well holes which the contractor drilled on the center line of the tunnel for this purpose. Electric light was used in the tunnel. Water encountered, amounting to 20 gal. per minute, was pumped to the surface through one of the drill holes and during the lining this water was used for the concrete. Tunneling was begun June 28, 1923, and holed through on April 8, 1924.

Work was then begun in trimming the floor for concreting. One side was excavated to subgrade and poured; then the track was shifted to that side, and the other side excavated and poured. An 800-ft. gap was left where the main supply of water came in, as the water table was near the floor and it was thought the concreting of the floor might diminish the supply below what was needed for concreting. Wood forms were built in 12-ft. sections and set for a length of about 90 ft. The ribs carrying lagging to the spring lines were wired and braced to the tunnel timbers.

When the form was filled to the spring line, a section of lagging was put in on each side and filled. The lagging for the top or keyway was in 4-ft. sections and the top was poured 24 hours after the sides. The surface was given a face on a radial line so as not to weaken the arch. Forms were removed five days after the top was poured. Two shifts a day placed concrete and one shift set forms.

The concrete mixer was located in the bottom of a draw 40 ft. deep at 1,400 ft. from the north portal. Materials came by gravity from stockpiles on the level ground near. Cement came down a chute from the cement house and the water came from storage tanks on the edge of the draw. The mixer discharged through a shaft into the tunnel directly into cars which were hauled through the tunnel with a tractor mounted on a locomotive traction frame and fitted with special gears to give the same speeds in either direction. In filling the forms, the cars were run up an incline onto a platform on trucks inside the forms.

Building Data Based on 12 Years' Work

ITEM	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Yds. Concrete per Sq.Ft. Floor Area	0.045	0.046	0.055	0.057	0.058	0.062	0.063	0.059	0.056	0.055	0.054	0.053
Lb. Steel per Sq. Ft. Floor Area	3.25	3.72	6.56	5.65	5.72	6.20	5.85	6.13	6.42	5.51	5.58	5.66
Bbls. all Cement per Yd. Concrete	1.62	1.65	1.63	1.67	1.65	1.72	1.78	1.83	1.83	1.76	1.63	1.78
Yds. Stone per Yd. Concrete	0.86	0.85	0.85	0.83	0.84	0.86	0.87	0.89	0.89	0.83	0.86	0.85
Yds. Concrete per Ton Steel	17.7	14.6	15.9	15.0	17.4	17.4	16.2	17.6	15.9	19.0	17.4	19.5
Bd. Ft. Forms per Sq.Ft. Floor Area	2.34	2.04	2.56	1.67	1.95	2.02	1.69	2.59	2.34	2.07	2.42	2.02
Average per Yard, all Forms Measured					36.30	32.10	27.00	43.00	42.00	37.20	44.30	38.10
Labor as Per Cent of Val. of Bus. Done					31%	30.5%	25.2%	27.4%	30.3%	30.2%	31.0%	32.2%
Val. of Business per Sq.Ft. Floor Area	$1.20	$1.32	$1.75	$1.10	$1.52	$2.10	$1.53	$4.37	$4.60	$4.58	$2.78	$3.71
Val. of Business per Yd. Concrete	$26.80	$28.80	$32.60	$25.10	$38.40	$38.70	$42.50	$53.70	$53.00	$53.20	$51.20	$69.70

SEVERAL interesting items of building construction have been compiled by the Turner Construction Co., New York, and included in chart form which is herewith reproduced. These data are the record of twelve years' building. The chart is self-explanatory.

From Job and Office

Hints that Cut Cost and Time

Economy in Design of Flat-Slab Floors

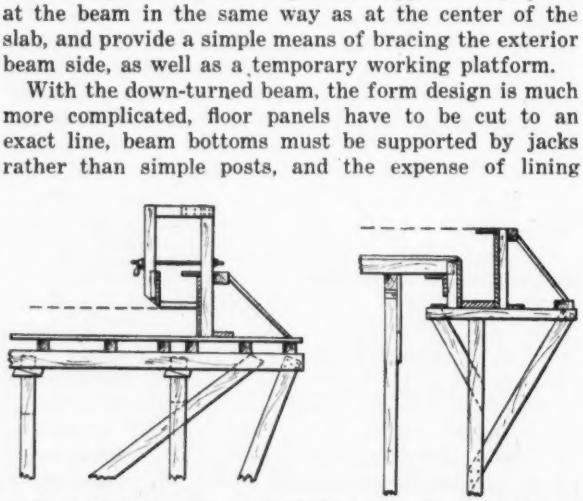
BY B. P. FLOYD
Traveling Superintendent, Aberthaw Co., Boston

THERE is one point in flat-slab concrete design that is of great importance to the constructing field force although, apparently, not given much consideration by the average designer. This is the matter of wall beam which is often designed as a down-turned beam with the slab resting on the top and sometimes designed as an up-turned beam with the slab supported at the bottom.

The up-turned beam is so distinctly advantageous in every way that I believe every designing engineer would do well to give this point consideration. After a very broad experience in the construction of many concrete buildings and the supervision of many others, I have come to the conclusion that in the average concrete building the use of an up-turned wall beam effects a saving equal to at least 1c. per sq.ft. for the total floor area. This amounts to several hundred dollars in a good-sized building.

With the up-turned beam, the floor panels are extended beyond the building line, supported by posts at the beam in the same way as at the center of the slab, and provide a simple means of bracing the exterior beam side, as well as a temporary working platform.

With the down-turned beam, the form design is much more complicated, floor panels have to be cut to an exact line, beam bottoms must be supported by jacks rather than simple posts, and the expense of lining up and bracing the exterior beam side is much greater than in the case of the up-turned beam.



FORMWORK FOR UP- AND DOWN-TURNED WALL BEAM

Not only does the up-turned beam favor the builder and, also, the cost, but it is a distinct improvement to the building inasmuch as it brings the sash up to the ceiling line and does away with the dark pocket formed by a down-turned beam, giving a better lighted floor.

The accompanying sketch shows the Aberthaw standard form design for an up-turned beam compared with the design using the down-turned beam.

From Job and Office

For Contractor and Engineer

Method for Testing Fine Aggregate

By G. W. Hutchinson
Eastern Manager, Concrete Dept., Celite Products Co., Chicago, Ill.

LOCALITIES possessing an abundance of well-graded sands, sound in structure, have no difficulty obtaining fine aggregate for concrete to pass present standard tests. Some parts of the country are not so fortunate as to possess such materials, and when requirements for fine aggregate, at least equal in tensile and compressive strength to standard Ottawa sand, are enforced, it becomes necessary to import sand at high cost. Many times local sand is available in more or less abundance and can be secured cheaply, although it may not meet the standard mortar test requirements. It follows that such limited supply and high freight rates increase construction costs. A condition such as this was encountered in North Carolina at the beginning of its expenditure of $65,000,000 for highway construction and it was necessary to find a suitable test for the local deposits.

Inasmuch as standard test methods were of questionable economic value, investigation was carried on to devise a method of test which would be more consistent with the use of fine aggregate under field conditions. The main objections to the standard test for strength were that it confused quantity with quality; gave no allowance for increase in relative strength with age; did not react uniformly with cements possessing different characteristics; and in general appeared inconsistent in its relation to the fine aggregate itself and the other constituents of concrete in place. Certain arbitrary features such as consistency, ratio of cement to fine aggregate, mixing time, etc., which as employed in the laboratory bear no relation to field conditions, have an effect upon the acceptance or rejection of natural sands. Last, but not least, enter the personal equation and storage conditions.

It seemed logical that a test of the fine aggregate made into concrete using standard cement, coarse aggregate, consistency, and compared with similar specimens in which the sample sand was replaced by an equal volume of standard Ottawa sand, should be investigated. It would be the most consistent method by which to determine suitability of fine aggregate for concrete and allow broader interpretation of the laboratory tests not only for comparison of strength ratio with standard Ottawa sand, but also comparison of the relative increase in strength with age; the volume of completed concrete obtained; the necessity for high early or high later strength in the structure as well as the additional cost of other available deposits and that of additional cement when the strength ratio is low.

The method adopted by the North Carolina State Highway Commission consists of proportioning the materials for a given volume of concrete as follows: 23 per cent cement; 46 per cent fine aggregate; 76 per cent coarse aggregate, all by dry volume, such volumes being transferred to a weight basis for measuring the amounts used. A standard consistency measured by the flow table was adopted, and was analagous to that required in field concrete. The specimens were 3 in. x 6-in. cylinders using prepared coarse aggregate (Mascot Chats) graded ¾ in. to ¾ in. All specimens were stored in a moist closet until tested.

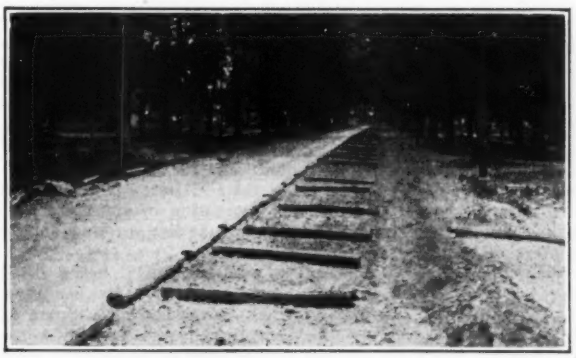
Locating Culvert Pipe Inlets and Outlets

By B. R. Linley
North Carolina Highway Commission, Sanford, N. C.

MANY highways are marred by the improper location of culvert headwalls. It is believed that this inharmony of road and culvert structures can be overcome considerably by the proper placement of culvert pipe inlets and outlets. Headwalls must intersect the slope of the fills at the right place or they will appear either too far from the road or the fill will wash down over the pipe ends.

In locating headwalls and inlets and outlets, first determine the station on the center line of the road at which the pipe is to be located. Then compute the elevation of the grade at this determined station at the shoulder and next the elevation at which the inlet must be placed to drain the adjacent land. This will be the elevation of the flow line of the inlet. Calculate the difference in elevation between the shoulder of the road and the flow line of the inlet and multiply this by the fill slope and add the product to half the width of the road from shoulder to shoulder. From this result deduct 2 ft. for an 18-in. pipe, 2.8 ft. for a 24-in. pipe, and 3.6 ft. for a 30-in. pipe. This distance, measured from the center line of the road, will be the point at which the inlet end of the pipe should come. The outlet end, of course, is found by the same procedure. If the pipe is on a skew the ends will be at different stations on the center line of the road.

Ties Protect Concrete While Curing



THE photograph herewith reproduced shows one of the popular methods employed by contractors in protecting concrete highways in Massachusetts while they are being cured. One-half of this 20-ft state highway is cured while the other half is open to traffic. A 2-in. covering of gravel is spread over the newly-laid concrete and is kept wet for 10 days. All traffic is kept off the concrete until the expiration of 14 days after pouring.

Rock Tunneling Costs in Norway

In our issue of July 2, p. 26, there were two graphs prepared by Einar Moe, of Norway, giving the cost of rock tunneling by hand and by machine methods in Norway. The captions for the two graphs were interchanged in making up the paper and as a result the graph showing the cost of hand drilling is shown as being that of the cost of machine drilling and vice versa.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Multiple-Arch Dams Exposed to Frost

Sir—I fully agree with M. M. O'Shaughnessy who takes exception in your issue of July 30, p. 194, to the primary cause which has been assigned for the failure of the Gem Lake multiple-arch dam, namely, the formation of ice on the exposed surfaces of the thin concrete arches.

It is recalled that the great danger of temperature cracks in the thin arches of this particular structure received considerable emphasis in the discussions in *Proceedings*, Am. Soc. C. E., p. 850, vol. 81, 1918. However, there is no present evidence as to the occurrence or otherwise of such cracks and it is not necessary to enter the realm of conjecture to determine the primary cause of this failure.

The description of the repairs to this dam on p. 22 of your issue of July 2 was of particular interest to me as our own investigation of this structure last year had led us to the conclusion expressed by Mr. O'Shaughnessy. The original construction work was done with at least ordinary care and skill, but it had been found expedient to use as part of the coarse aggregate the rather poor grade of limestone procured from the excavations, which contained about 10 per cent of shale. This shale, micaceous sand and perhaps too wet a concrete mixture permitted the formation of minute water channels through the arches, freezing action starting on the underside and progressing upward.

The dam was constructed in 1916 and 1917, being filled for the first time in the summer of 1917. Its designer, L. R. Jorgensen, in the 1917 *Proceedings* stated: "Some of the arches on the Gem Lake dam are absolutely tight, some of them sweat in places, and a few drip in places."

Although not subjected to the temperature ranges of even one season, the concrete was then porous to a degree.

The watertightness of good dense concrete is fully established and after many years of study of waterproofing methods we rely on well proportioned concrete and dispense with integral waterproofing compounds and surface coatings.

My experience deals with about 165 dams of the conventional Ambursen designs, about 75 of which have been built in Canada, the Northwest and the New England States. Many of these structures are subjected to a temperature range of at least 120 deg., the low winter temperatures frequently ranging between 40 and 50 deg. below zero, considerably more severe temperatures than encountered in the Gem Lake district. The oldest of these dams is 22 years old.

Our established practice has been to check up on the condition of these structures every few years, and I feel that we are always fairly well posted on their condition. Out of these 75 dams we know of only three instances where the deck slab has deteriorated due to frost action and in each case porosity was the primary cause.

In one 18-year-old structure (in northern New York) the damage is trifling, being limited to two construction joints which obviously were not thoroughly cleaned before the next pouring of the concrete, thus affording a water passage through the deck slab.

In the second dam (Maine), 17 years old, the trouble is clearly due to what I believe was the actual difficulty with the Gem Lake structure, viz., treacherous concrete materials, perhaps coupled with a faultily proportioned concrete mixture, the work having been executed by force account with what we believe to have been lax supervision. We inspected this dam three months ago and found the concrete to be porous and poor in quality in the only three bays where any spalling off of the slab had occurred. It also contained flat pieces of shale that had escaped observation, though the quarry was known to contain such material.

The third case (Pennsylvania was a structure of fundamentally defective design by an inexperienced local engineer, constructed of dubious materials by a local builder with no conception of hydraulic requirements and supervised by a non-technical employee of the owner. When we rebuilt it in 1920 it showed rotten concrete in all parts, whether in contact with water or continually dry, and the decks had fallen an easy prey to frost action.

An interesting point in connection with the freezing of water beneath the deck (within) a hollow dam has been disclosed by our frequent inspection of full apron dams. Most of our 75 dams subjected to severe cold are of the open front type although many of them are entirely enclosed by the spillway apron carried to riverbed. We have never found that ice forms beneath the deck of the full apron (enclosed) dams regardless of the temperature to which they are subjected. The writer, during a recent inspection of the 21-year-old dam at Schuylerville, N. Y., observed that with an outside temperature of 20 deg. below zero and with drain openings 3 ft. square beneath the spillway bucket in each bay, the backwater standing within the dam had only a thin skin of ice at the downstream edge and was unfrozen directly beneath the deck slab.

It is therefore my belief that the Gem Lake dam could have been preserved at a comparatively low cost and the progressive deterioration of the concrete arches through frost action could have been arrested by the expedient of enclosing each bay with a timber or a thin concrete curtain wall.

That is the course we are following in protecting the Maine dam above referred to. During construction six bays in the main river channel were housed in with a vertical concrete curtain wall to prevent drift ice piling up within the dam. Also, there are a number of bays that are annually enclosed by ice which builds up below the structure. Within these enclosed bays no freezing of backwater has ever been observed. The various engineers who have examined this dam are of the unanimous belief that the proposed wooden housing will maintain a high enough temperature within the structure to protect the porous concrete from further damage through frost.

SPENCER W. STEWART,
President, Ambursen Construction Co., Inc.

New York,
Aug. 7, 1925.

New Type Canal Lock Gates

Sir—In *Engineering News-Record*, July 24, 1924, p. 135, is described a "New Type Canal Lock Gate," developed in Sweden. This system has been in use for many years in Holland and is known under the name of "Waaiersluizen." Some of these locks are at the mouth of the Dintel, the Westersluis at Terneuzen and in the Close Dam near Andel used for separation of the River Maas and Waal. The last named locks have been in use since 1905.

Grand Rapids, Mich., J. T. H. SENTROP.
Aug. 7, 1924.

[This letter was submitted to Lars Lawski, author of the article on the Swedish lock gates, who replied as follows. —EDITOR.]

Sir—I received your letter of Aug. 13 and am sorry that the rush of work I was in last year before opening the Södertälje canal did not allow me to write an answer on the below mentioned matter before now. However, for the benefit of those who may be interested I enclose now a description of the difference between this sector gate and the Dutch "Waaierdeuren," in German called "Fächertoren." In fact the article in *Engineering News-Record* seems to me to be quite enough detailed to give a good idea of the difference for one who is familiar with the "Fächertor."

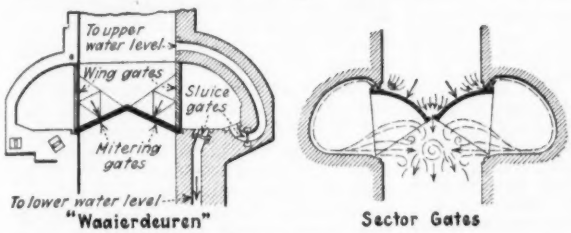
"Waaierdeuren," in German "Fächertoren" (Handbuch der Ingenieurwissenschaft Bd VIII, s 220-225; Lüger; Lexikon der Gesamten Technic) are lock gates based on a quite different principle than the sector gates, a slight resemblance existing on account mainly of a deep gate niche being used in both constructions.

"Waaierdeuren" are mitering gates. On account of the water pressure, the gates bear when in closed position both on each other and on the lockwall, like a three-hinged construction. Regarding operation, the gate is supplied with an operating wing or, looking from above, an arm placed 60 deg. or more to the gate and movable in a niche, resembling the niche for the sector gate. By joining this niche with the upper or lower water level through filling sluices,

a pressure on the operating wing is obtained—the wing being longer than the miter gate—thus making the operation of the gate semi-automatic. The movement of the gate is rather fast in the beginning, the difference between the water levels being quite large, but as that difference decreases the movement gets slower and finally at the last part of the movement, when the difference is too small to move the gate, it becomes necessary to apply hand power. The above-mentioned filling sluices run the full length of the lock on both sides and are provided with four sluice gates at each pair of lock gates. Together with the operating wings they make the operating machinery, which evidently is inferior to electric machinery. When the gates open, the water runs between the gates into the lock and makes a heavy current in the direction of the lock, which may be harmful to boats in the lock.

Consequently the same main difference exists between these two gate types as between a mitering gate and a tainter gate, as shown in the figure.

The "waaierdeuren," although well able to resist the



COMPARISON OF MITER GATES AND SECTOR GATES

water pressure in one direction when acting as mitering gates, on account of their construction are practically unable to resist any water pressure in the opposite direction (if the water pressure changes direction as in tidal locks). As a matter of fact there is a very large moment between the mitering gate and the operating wing, when the gate is being operated, which moment together with the above-mentioned heavy current is responsible for the "waaierdeuren's" having been used only in small locks and for small differences between the water levels. Gates of this type were constructed some fifty years ago at Vrieswük and Andel in Holland and Brunsbüttel in Germany but since that time no new ones have been built to my knowledge.

With the special type of tainter gate, that has been developed to meet the peculiar conditions in the Södertälje Canal at Södertälje, Sweden (*Engineering News-Record*, July 24, 1924, p. 135) a particularly favorable flow of water in the lock has been obtained, as only a small portion of the water passes between the gates, in the direction of the lock, while the main portion runs around the gates and through the gate niches into the lock, perpendicular to the direction of the lock, thus not disturbing the vessels that are there. On account of the sectional shape, the gates are able to take the water pressure from one side as well as from the other. No filling sluices or sluice gates are needed, which naturally simplifies both the construction and the operation of the lock.

LARS LAWSKI,
1st Engineer, Royal Board of Waterfalls and Canals.

Stockholm, Sweden,
April 21, 1925.

Irrigation Papers at Salt Lake Meeting

Sir—I have noted with some concern your report upon the proceedings of the Salt Lake meeting of the American Society of Civil Engineers published on p. 105 of your issue of July 16, 1925, as it refers to the paper presented by myself before the Irrigation Division. I am quoted in this article as disagreeing with Messrs. Hinderlider and Meeker of Colorado in regard to a solution of interstate water problems through interstate compacts. Quite the reverse is true, and I quote the following brief statements from my paper to demonstrate:

"To give some color to the idea expressed upon the program that this discourse is a discussion of the able paper presented upon the subject in hand by Messrs. Hinderlider and Meeker, I wish to add a few thoughts in support of their conclusion that the best solutions of interstate water problems will be found in amicable agreements largely expressed through interstate compacts.

"The third plan designated as a means of solution of interstate water problems is that through compact or treaty between states. To this plan the paper of Messrs. Hinderlider and Meeker has been largely devoted and an excellent presentation of the subject has been given."

By these and other expressions my paper heartily approved of the ideas expressed by the Colorado men rather than taking exception to them. Confusion upon the part of the reporter may possibly have arisen from the fact that I presented other plans for the solution of interstate water problems, but the presentation of the other plans was not intended to detract in any way from the desirability of what might be considered the most definite plan of solution as represented by interstate compacts. For your further information I quote another section of my paper:

"In contrast to this unfavorable experience when resort has been made to the courts, is the record of accomplishment obtained through friendly conference and mutual agreements. Favorable progress toward the solution of interstate water problems has been made by Wyoming along what may be considered as three different lines of effort, viz: First, by what may be considered as a 'gentleman's agreement,' as exemplified by the North Platte River Co-operative Investigations; Second, by reciprocal statutory enactments and agreements between states, as is evidenced by the negotiations and agreements concerning interstate streams between Utah and Wyoming; and Third, by interstate compact such as is now under negotiation in respect to both the Green and the North Platte River of Wyoming. Comment will be made upon these three plans in order."

An important phase of my paper in my opinion was that calling attention of engineers to the necessity of taking an active part in what might be termed the political end of interstate relations, and to indicate my feeling I quote:

"In the matter of interstate compact, engineers should feel called upon to take a hearty interest. The speaker was greatly disappointed in not being able to attend the mid-summer meeting of this society held at Pasadena last year at which the discussion was largely confined to Colorado River problems. It was interesting to note that questions concerning the engineering features of river development had much attention and that oftentimes the arguments pro and con as to the locations of dams and the most logical development of the river from a physical standpoint reached a rather heated state. The political question of interstate relations seemed to have but little atention. Why should engineers devote themselves so industriously to considerations of a technical character to the practical exclusion of the larger political questions upon interstate streams that would handicap, if not entirely preclude, any large development of the water resources until the political phases of the matter receive intelligent attention and solution? In my mind it should be as much the function for engineers to give their attention and assistance to the solution of the political questions involved by interstate problems as to the engineering phases of same. And until they take such attitude they will fall short of the mark of the service that they are in a position to render.

"In rapid conclusion, I wish again to voice both 'my hope and firm conviction' that the best solutions of interstate water problems will come through intelligent conference and amicable agreement. Litigation means that decision will need to be made from a mass of testimony, generally conflicting in the extreme and well flavored with prejudice throughout. Solution through interstate agreements, worked out in harmony through the careful consideration of all facts and equities involved, means that justice will be done as far as humanly practicable to all parties in interest, and with the greatest saving possible in time and expense. I wish especially to emphasize my thought that engineers as a body should give their attention to the political phases of interstate questions without the solution of which all our technical devotions may be largely in vain."

I trust that you will call attention to the evident error in reporting my paper in order that there may be no misunderstanding. Several communications have come to my desk in the past few days in regard to this misstatement of fact.

FRANK C. EMERSON,
State Engineer of Wyoming.

Cheyenne, Wyo.,
Aug. 4, 1925.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Governor Issues Ultimatum on Colorado River

Arizona Governor Puts an End to Tri-State Conference by Taking an Uncompromising Attitude

A conference to discuss the mutual interests of California, Arizona and Nevada in the development of the Colorado River was opened in Phoenix on Aug. 17 by representatives of these three states. The representatives of California and Nevada had been appointed by the legislatures of their respective states but in the case of Arizona representatives had been appointed by Gov. George W. P. Hunt to take precedence over appointments made for this purpose by the Arizona legislature.

The opening session of the conference was also the last because it seemed that there was nothing to be done in view of Arizona's attitude as outlined by the Governor. His address to the gathering was in the nature of an ultimatum as well as an attack on the Colorado River compact; he took the position that Arizona would not sign away its rights to the Colorado River without recompense. "If we have something you want and can utilize, economic justice dictates that it be paid for. . . ." he said. "The state of Arizona expects to derive revenue from every unit of electrical energy generated in this state that is used in other states." Regarding the doctrine that states of the upper basin have some claim to power developed in the lower basin he said, "I deny any such right exists. I repudiate such doctrine."

With reference to federal relations he said: "I hope that some day that usurped right of the United States will be challenged and that Arizona may have the opportunity to show in the Supreme Court that when the Congress of the United States made the reservations as to power sites, it exceeded its authority in denying admittance of the territory of Arizona to the union of the states, which comprise the United States, on an equal basis with all of the other states."

In summing up his remarks to the conference, Governor Hunt stated: "I believe that any decisions you may reach should first of all stipulate that no treaty allocating the waters of the Colorado River shall be effective until it is fully established between the United States government and the Mexican government that no water rights will accrue to Mexican lands resulting from any storage facilities provided on the Colorado River or any of its tributaries. Second, I believe that all the water that may remain unappropriated for beneficial use, under the terms of the Colorado River compact, by the upper basin, should be the basis of apportionment in the lower basin rather than that the allocation be limited to 8,500,000 acre-feet appropriated by the compact."

Meantime the upper basin states had tentatively set Aug. 27 as the date for a meeting of representatives of Utah, Colorado, Wyoming and New Mexico.

Engineering Fifty Years Ago

From *Engineering News*, September, 1875

THE ROADS in the Chicago parks, where only light vehicles are allowed, are made in alternate layers of clay and lake shore gravel. The sub-grade is prepared with the same crown as the road should have when finished, and on this is first spread about two inches of clay, on that a layer of coarse clean gravel, which is then rolled with a heavy roller, so as to embed the gravel in the clay; a layer of two inches of clay is then spread upon that, and on the clay, about an inch of finer gravel; the whole is then well rolled. If there is too much clay, so that the road is sticky on the surface after rain, a little more gravel is added until the surface becomes clean and hard; these roads are better than either a gravel or macadamized road with the material we have here, being much less dusty, much more easily kept in repair, and costing about half what the others do.

Chicago Under Pressure Adopts Meter Ordinance

On Sept. 1 the Chicago City Council, hurriedly called in special session by the Mayor, by a vote of 34 to 17 passed an ordinance initiating compulsory metering of the water supply. The action was the direct result of the refusal of the War Department to extend the time beyond Sept. 3, when the Chicago City Council was to have provided a ten-year water metering program as a condition under which the Sanitary District of Chicago may withdraw 8,500 sec.-ft. of Lake Michigan water for sewage dilution. The council some time ago had adjourned until Oct. 29, despite the efforts of the administration officials, including Mayor Dever, Col. A. A. Sprague, commissioner of public works and John Ericson, city engineer, to impress upon it the necessity for a metering ordinance.

Many of the aldermen went into hiding and failed to respond. Others gave out interviews indicating that for them to vote for a metering ordinance was political suicide. Still others resented federal interference in local affairs and proposed a junket trip to Washington to ask for the removal of the local government engineer in charge, Major R. W. Putnam.

Dam Creates Sewage Problem at Twin Cities

Pool Formed Above High Dam Holds Back Sewage from St. Paul and Minneapolis

The sewage disposal problem caused by the "High Dam" across the Mississippi River between Minneapolis and St. Paul has been brought to the attention of the city councils of the two cities by the State Board of Health. The question has been taken up by the Metropolitan District Planning Committee which has appointed a sub-committee to consider the matter, consisting of W. L. Darling, chairman, formerly chief engineer of the Northern Pacific Ry. Co., a member of the St. Paul City Planning Board; A. Y. Chute, realtor, Minneapolis, and J. T. Elwell, president of the Minneapolis City Planning Board. This committee has been instructed to confer with the State Board of Health in going over the data already collected relating to river pollution within the Metropolitan district, an area of 27 miles radius.

All the sewage of Minneapolis and some of that of St. Paul now discharges into the lake formed by the "High Dam," which extends for 4.8 miles between the dam upstream nearly to the foot of St. Anthony Falls in Minneapolis. The lake has a normal depth of 37 ft. at the dam and of 9½ ft. at the Washington Ave. bridge, Minneapolis.

A possible future problem similar in general character may arise if the proposed dam across the Mississippi River, just below the confluence of the St. Croix and Mississippi is built, but the city chiefly affected in this case will be St. Paul. The construction of this dam is before the War Department and a hearing on the subject was held in the United States Engineers Office, St. Paul, on Aug. 17.

Civic action by the authorities of the two cities on the communication from the State Board of Health has thus far been confined to committee reference by the Minneapolis council and by the suggestion of the mayor of St. Paul that a joint commission to consider the whole matter should be created, consisting of the chief engineering officers of both cities, a member of the State Board of Health, and others, this committee to work jointly with the Metropolitan District Planning Committee to draft necessary legislation to be submitted to the next legislature of Minnesota which will meet in January, 1927.

At a meeting of the Metropolitan District Planning Committee on Aug. 27, Mr. Chute and Mr. Elwell resigned from the sewage disposal committee and Mr. A. C. Godward, city planning engineer of Minneapolis, and George H. Herrold, city planning engineer of St. Paul, were appointed in their stead.

Seaboard Air Line Building Up a New Railway in Florida

The Seaboard-All Florida Railway Co. has applied to the Interstate Commerce Commission for authority to build up a new railroad to include a line from West Palm Beach through Miami to Florida City; the new railroad construction is as follows: (a) From a connection with the Florida, Western & Northern at West Palm Beach to Miami and Florida City, a distance of approximately 100 miles; (b) from a point near Fort Ogden on the Charlotte Harbor & Northern Ry. to Fort Myers, approximately 36 miles; (c) from Fort Myers to the south bank of the Estero River, approximately 14 miles to connect with the proposed Naples, Seaboard & Gulf Ry.; (d) from Fort Myers to a point on the Caloosahatchee River in the direction of Labelle, 33 miles; and (e) from a point on the Fort Myers-Estero line to Punta Rassa, a distance of 11 miles.

The company is also asking for authority to acquire the following lines which are under construction or in the process of completion: the Florida Western & Northern R.R. from Coleman to West Palm Beach, 204 miles; a cut-off 11 miles long from Gross to Callahan, and a cut-off from Valrico to Welcome Junction, a distance of 13 miles, both now under lease to the Seaboard Air Line; and the East & West Coast Ry. from Bradentown to Arcadia, a distance of 47 miles, the stock of which is now owned by the Seaboard Air Line. All of the above properties, when constructed or acquired, are to be leased to the Seaboard Air Line Railway Co.

The Brooksville-Inverness Ry., a subsidiary of the Seaboard Air Line, has applied to the Interstate Commerce Commission for authority to construct a railroad 18.7 miles long to extend from a connection with the Tampa Northern at Brooksville to a connection with the Seaboard Air Line at Holder, Fla. The proposed line will reduce the distance from Inverness to Tampa to 70 miles, or approximately 172 miles less than the present route. It will also postpone the double tracking of a portion of the Seaboard Air Line for a number of years.

Data To Be Collected on Highway Construction Abroad

Organization of a Highway Section in the Transportation Division of the Bureau of Foreign and Domestic Commerce for the purpose of collecting information on highway construction and development abroad is announced.

The work of this new section will commence at once, and consuls, trade commissioners, commercial attachés and other government representatives stationed throughout the world will be requested to make periodic reports on status of highways in their particular areas, projects for extension and other matters having a bearing on these subjects. A survey of market possibilities for the sale of road building machinery through the world is also contemplated.

Philadelphia - Camden Bridge Work Held Up by Commission

Work on the bridge over the Delaware River at Philadelphia will probably be stopped upon completion of present contracts due to action taken on Sept. 1 by the New Jersey Interstate Bridge and Tunnel Commission, in the controversy over tolls to be collected on the bridge. After an executive session the commission gave out the following resolution:

"Resolved, That the members of the New Jersey Interstate Bridge and Tunnel Commission refuse to vote for the letting of any further contracts for the completion of the Delaware River Bridge or for the expenditure of any more money for work not now under contract until the tolls question has been settled and New Jersey's right to collect tolls is fully recognized."

This action is the result of a controversy between the representatives of New Jersey and Pennsylvania resulting from a difference of policy in regard to the collection of tolls. The state of New Jersey favors the collection of tolls to help defray the cost of its two joint undertakings, the Philadelphia-Camden bridge and the Holland vehicular tunnel at New York. The Pennsylvania legislature, however, at its session this year, declared itself in favor of a free bridge.

The controversy will probably result in a long delay to the bridge work as contracts amounting to $2,000,000 are yet to be let. As the Pennsylvania legislature meets only biennially it will be 1927 before it can take further action unless a special session is called.

An Investigation of Culvert Pipes Begun

A new investigation of culvert pipes has been begun by the Highway Research Board of the National Research Council, Washington, D. C., with R. W. Crum, engineer of materials and tests, Iowa State Highway Commission, as chairman of the investigation. The objects of this study are: To correlate various tests and experiments on pipe loads and stresses; to set up a standard of comparison of the life of different kinds and classes of culvert pipe; and to determine the most probable conditions of service for which standards should be designated. Mr. Crum, who is a graduate of Iowa State College, was for 12 years associate professor of civil engineering there and since 1919 has occupied his present position with the State Highway Commission. While with the Iowa State College he was engaged on research work for the Iowa Engineering Experiment Station.

Municipal Office Building for City of Baltimore

The City of Baltimore is having plans prepared for a municipal office building to be erected at Lexington and Holliday Streets at a cost of approximately $2,000,000. W. H. Emory, Jr. has been made architect.

Almert Resigns as an Executive Officer of the A. A. E.

Harold Almert has resigned from the position of general manager and secretary of the American Association of Engineers. The resignation was accepted at the Aug. 8 meeting of the executive committee of the association. Mr. Almert was elected president of the association in June, 1924, but resigned the position in January and was at once employed by the board of directors as directing manager. Three months later the secretary, C. E. Drayer, resigned, and in June Mr. Almert was appointed general manager and secretary. The duties of secretary will now be exercised by Miss M. E. McIver, acting secretary, while general administration of the association's affairs and editing its journal, *Professional Engineer*, will be in the hands of D. B. Steinman, president.

Kansas City Garbage to Be Made Into Hog and Chicken Feed

After a struggle over garbage collection and disposal at Kansas City, Mo., lasting more than two years, during which three contracts were let and two were taken into the courts, the contractor who received the latest award has come to an agreement with the one who got the original and a so-called emergency contract and has sublet the contract for disposal only to a reorganization of the people interested in the first two contracts. Under the final arrangement, Paul Patton, the successful one of three bidders in March, 1925, will collect the garbage and turn it over to the reorganized company just mentioned for conversion into hog and chicken feed by a process said to be controlled by the Pan-American Feed Milling Co. A communication relating to the controversy and the specifications under which bids were received and the contract awarded to Mr. Patton will appear in a later issue under "Letters to the Editor."

Three Earth Filled Dams to Be Built for Flood Control

The Los Angeles County Flood Control District is calling for bids for the construction of three earth dams on Puddingstone Creek at a place known as the Puddingstone reservoir site. The three dams are to be entirely of earth fill with clay core walls with part of the embankment placed hydraulically and part as a dry fill. The total yardage in the three structures will be nearly one million cubic yards.

Harbor Works at Hollywood, Fla.

Construction of jetties, an entrance channel and harbor works at Hollywood, 17 miles north of Miami, Fla., is to be undertaken by the Hollywood Development & Harbor Co. The work will be done in large part by the use of hydraulic dredges using a number of 16-in. dredges and one 20-in. dredge.

WASHINGTON NOTES

In an effort to relieve the power shortage in the Southeast, to the extent within its power, the War Department, on Aug. 29, began the operation of one of the main 25,000 kw. generators at Muscle Shoals. It is expected that ten days would be required for the drying-out process. There is some uncertainty as to the amount of power which can be developed with the pool 11 ft. below the regular operating level; estimates vary from 12,500 kw. to 18,000 kw. for the 25,000 kw. unit.

As required by the last Congress, the Federal Power Commission and the Corps of Engineers are making up an estimate of the cost of a general survey of navigable rivers. A large amount of data has been sent in from the field, but compilation has not gone far as yet.

The need for basic information as to the water resources of the country's navigable rivers long has been recognized. The fees being paid into the federal Treasury for water-power licenses and for the use of government power structures would provide for a sufficiently detailed survey program.

Maj. D. C. Jones, the district engineer at Buffalo and his assistant, Capt. A. B. Jones, have been added to the membership of the board that is making a survey of waterway routes between the Great Lakes and the Hudson River.

The Attorney General announced on August 20 that the work on the opinion as to the scope of the Federal Trade Commission's investigations is nearing completion. The act carrying the Commission's appropriations for the current fiscal year contains a proviso that the funds are to be expended only on investigations ordered by both Houses of Congress or upon an investigation ordered by one House involving alleged violation of the anti-trust statutes. The Commission is in doubt as to the exact requirement of the law in that connection and asked for an opinion.

There is a possibility that the opinion may halt the Commission's investigation of the General Electric Company. While the resolution adopted by the Senate makes no direct allegation of violation of the anti-trust acts, it does direct the Commission to ascertain if there has been violation of those laws and charges were made on the floor of the Senate that there had been such violations.

Lake Huron, now having fallen to a level of 578 ft., is nearly a foot lower than it was in 1895, the lowest point of record. Records of the lake levels have been kept since 1860.

Land bank appraisers report that farms on highly improved highways enjoy transportation advantages which are making it more and more difficult for the farm on a poor road to compete. This situation is having a decided influence on land values and in some states where the highway program is lagging.

The Secretary of the Interior on Aug. 12 was urged by a committee of American Engineering Council to support legislation providing for an inventory of the water resources of the United States. A bill has been drafted by Engineering Council which provides that such a study be made by the Geological Survey.

The bill, which will be introduced at the next session of Congress provides for the carrying out of "a comprehensive plan for developing both surface and ground waters for domestic and industrial supplies, irrigation, navigation, power and other uses and for the conservation and control of flood waters." It provides for cooperation with the states to those ends and suggests that the federal government expend $500,000 annually for twenty years for its part of the work.

Until some practical method for removing oil from ship discharges is devised, Secretary Hoover sees no purpose in calling an international conference on oil pollution. This country was authorized by Act of Congress three years ago to participate in such a conference.

Since no practical way has been developed that will permit of the disposal of oil wastes at sea, Mr. Hoover thinks it would be better to await the solution of the mechanical end of the problem so a conference would have a chance to accomplish something. A first class opportunity thus is presented, Mr. Hoover said, for a mechanic to make a fortune.

The problem is receiving attention in the bureaus of standards, fisheries and mines and at the hands of foreign agencies. This government is exchanging data with the other governments that are working on the problem.

New Indictment in Pickwick Club Collapse

Three more men have been indicted in connection with the collapse of the Pickwick Club in Boston on July 4, noted in our issues of July 9, p. 75; July 16, p. 115, and Aug. 20, p. 319. The men are Martin M. Kane, a concrete inspector for the city; Linton Hart, vice-president and general manager of the Charles R. Gow Co., the company which did the underpinning of the wall of the Pickwick Club; and Charles A. Leary, general superintendent for the same company. Both Mr. Kane and Mr. Leary were witnesses in the recent trial of 12 other men, indicted in the same case, all of whom were acquitted.

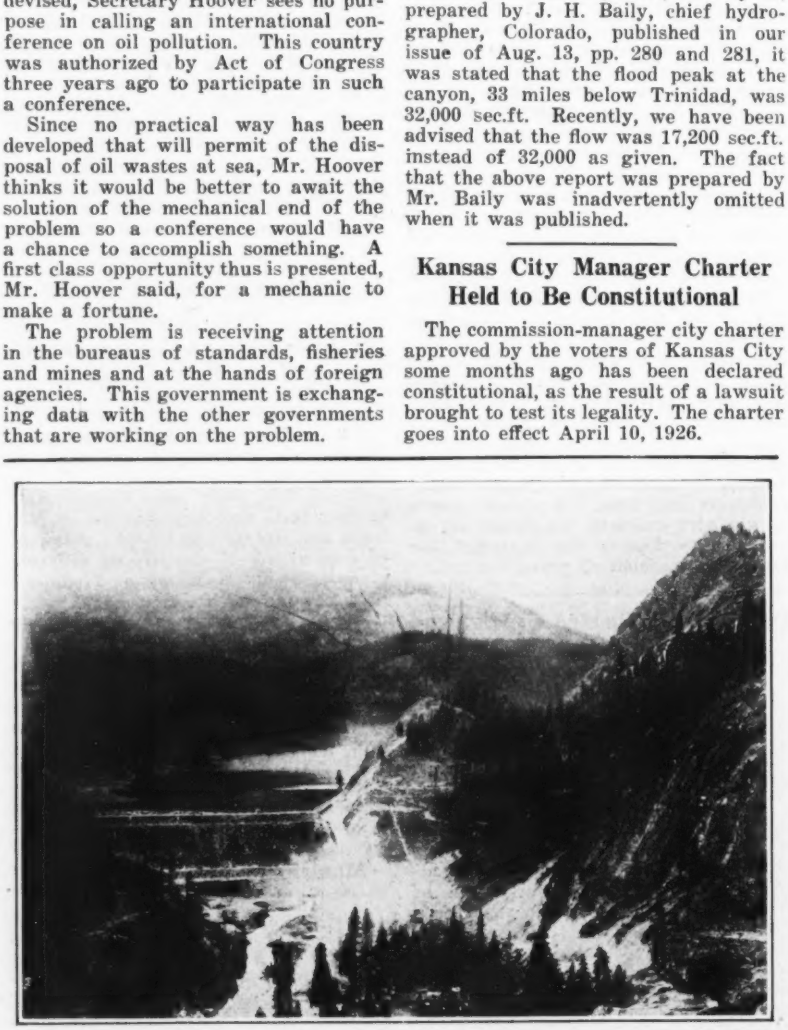
On Aug. 31 a fourth man was added to the list of new indictments brought in connection with the club collapse. He is is Nicholas Corrangelo, foreman of the construction gang, who also is charged with manslaughter.

Flow Figures—Trinidad Flood

In the description of the flood which occurred at Trinidad, Colo., on July 22, prepared by J. H. Baily, chief hydrographer, Colorado, published in our issue of Aug. 13, pp. 280 and 281, it was stated that the flood peak at the canyon, 33 miles below Trinidad, was 32,000 sec.ft. Recently, we have been advised that the flow was 17,200 sec.ft. instead of 32,000 as given. The fact that the above report was prepared by Mr. Baily was inadvertently omitted when it was published.

Kansas City Manager Charter Held to Be Constitutional

The commission-manager city charter approved by the voters of Kansas City some months ago has been declared constitutional, as the result of a lawsuit brought to test its legality. The charter goes into effect April 10, 1926.



COMPLETED TIETON DAM, YAKIMA RECLAMATION PROJECT

Important Questions Before the Bureau of Reclamation

Special Correspondence

Proposals to turn over the Belle Fourche irrigation project to settlers is not favored by administrative officers dealing with reclamation. Under present conditions, it is contended, no contract with the district would be worth the paper on which it is written. The project can be salvaged only if earning power on farms can be developed.

Forty-nine per cent of farms comprising the Belle Fourche project are unoccupied. A large percentage of resident cultivators are tenants. Much land is owned by banks and mortgage companies. Efforts to enforce collections this year have failed. The district board has submitted a proposal to pay fifty cents an acre, which would raise only half the operating expense.

It is contended that a moratorium should not be granted. The feeling is that those who are working their land should pay and those who are doing nothing ought not to be allowed to continue. There is a firmly held opinion that action should be taken to enforce collections from the land that is now unoccupied or take it under foreclosure proceedings and settle it with experienced farmers. If that is done and a crop program prescribed that includes livestock and sugar beets, it is believed that Belle Fourche can be made as good an irrigation project as are those in eastern Colorado or the Salt Lake Valley.

The Bureau of Reclamation gradually is building up a cross-section of the opinion of impartial authorities with regard to its new policies. It is entirely evident that the majority believes that all new development, public or private, requires for its success a program of aid and direction in settlement and farm development. The majority also recognizes that the success of federal reclamation will be promoted greatly by co-operation with state and local agencies which will require from them some efforts and financial responsibility. The opinion also is held very generally that the difficulties of federal reclamation should not be multiplied by undertaking new work, where there is any doubt as to financial results, until the program of salvaging the older projects has been worked out and an end has been brought to the opposition to payments. There is evidence that a majority of the water users approve of enforcing collections.

The new policies of the Bureau of Reclamation have been endorsed in a formal resolution adopted by the state Chamber of Commerce of Washington and by other civic organizations of that state. "The selection of settlers and the solution of other economic problems on the irrigation projects," the resolution states, "should be made by the Commissioner of the Bureau of Reclamation of the U. S. Department of the Interior in co-operation with the states or reclamation or irrigation districts or local corporations organized for that purpose."

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER-WORKS ASSOCIATION, Boston, Mass.; Annual Convention in connection with trip on St. Lawrence River, Sept. 8-11, 1925.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Fall Meeting, Montreal, Que., Canada, Oct. 14-16, 1925.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Convention, St. Louis, Mo., Oct. 19-22, 1925.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Lakeland, Fla.; Annual Meeting, Des Moines, Iowa, Oct. 26-30, 1925.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, Detroit, Mich., Nov. 18-20, 1925.

The Iowa Section of the American Water Works Association will hold a meeting at Dubuque, probably Nov. 25 to 27. Jack J. Hinman, Jr., Iowa City, is secretary of the Section.

The Canadian Good Roads Association will hold its annual convention at the city of Quebec, Sept. 22, 23 and 24, 1925.

Personal Notes

H. C. JESSEN, principal assistant engineer, has been made city engineer of Salt Lake City Corporation, succeeding Sylvester Q. Cannon, who, as noted in these columns some time ago, has left the department to become presiding bishop of the Mormon Church.

CHARLES B. HAGEN, for eight years a member of the Board of Water Commissioners, Welland, Ontario, and for three years chairman of the board, has resigned and has been appointed chief inspector of the new city water-works now in course of construction.

F. C. HOUGHTEN has been appointed director of the research laboratory of the American Society for Heating and Ventilating Engineers, of which society he is also secretary. Mr. Houghten was formerly first assistant to the dean of the laboratory and during the war carried on research in the U. S. Bureau of Mines.

CHARLES BOONE, engineer in charge of a section of the Lincoln Highway construction work, Indiana State Highway Commission, has accepted a position with the Columbus, Ohio, district office of the Portland Cement Association. Mr. Boone is a graduate of Purdue University and has spent eight years in highway and municipal engineering work, having served as surveyor of Hancock County, Indiana, and as city civil engineer of Greenfield, Ind.

EDWARD E. HASKELL, former assistant city engineer, Santa Barbara, Calif., was appointed city engineer to succeed George D. Morrison, who resigned last week. Mr. Haskell comes from four years on construction work on the Hetch Hetchy water supply project for the city of San Francisco.

FRANK Y. HARDY, who for several years has been assistant chief bridge designer of the Indiana State Highway Department under Ralph E. Finlay, who has resigned, has been made chief designer, and JOHN OLIVER, assistant force engineer, has been promoted to fill the vacancy created by the resignation of J. S. Neibert, force engineer. R. E. SIMPSON has been appointed as office engineer in the engineering department vice John M. Henry, resigned.

JAMES K. JAMES has been reappointed city engineer and street superintendent in Santa Cruz, Calif., a position which he previously held from 1919 to 1923.

Obituary

LINDLEY M. RICE, Seattle, Wash., contractor and engineer, died suddenly Aug. 21, aged 56 years. Mr. Rice spent his life in railroad construction, in the United States, British Columbia and Alaska, and also in reclamation district construction. He did much engineering work for the Canadian Pacific and was with the Great Northern Ry. during its original construction work. He was at one time chief engineer of the Quincy Valley, Horse Haven and Yelm irrigation districts. He was born in Kentucky and graduated from Georgetown College in that state.

DR. CHARLES F. CHANDLER, former president of the health department of New York City and also of the American Chemical Society, died at Hartford, Conn., Aug. 25, aged 88 years. Dr. Chandler, as head of the health department of New York City from 1867 to 1884, brought about the regulation of gas, milk, kerosene and city water, and established many other sanitary measures in the city. He was instrumental in the organization of the American Chemical Society and for many years was editor of the *American Chemist*. He was one of the founders of the School of Mines of Columbia University, in which he held the professorial chair of chemistry for many years and of which he was dean for 33 years. Dr. Chandler was born in Lancaster, Mass., and educated at Harvard University and the universities of Berlin and Gottingen.

JOHN H. CRAWFORD, Frankfort, Ind., who had been engaged as a drainage contractor for more than fifty years, died recently in Frankfort, at the age of 72 years.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Steel Fabricators Form Trade Board

The formation in New York City of the Structural Steel Board of Trade by fabricators of structural steel marks the entrance of the construction industry into a field heretofore experimented in only by the manufacturers of electrical equipment. The Electrical Board of Trade, Inc., has been in existence for some time. Its chairman, Charles L. Eidlitz, has also been made chairman of the new Structural Steel Board of Trade.

The chief purpose of the new board is to develop a high standard of service to the structural steel user, to secure fair treatment of its membership by the building trade, and to gather statistics which are to be made available not only to its members but to architects, engineers, and contractors. The board has nothing whatever to do with price policies.

The chairman of the board has rather complete power over all branches of the materials, equipment and appliance distributing industry in and around New York City. The sponsors of the board feel that it will prove to be a means of divesting the New York building industry of existing cost-multiplying practices and policies.

The officers of the Structural Steel Board of Trade are: W. A. Garrigues, Levering & Garrigues Co., president; R. C. Post, Post & McCord, Inc., vice-president; J. Lowenstein, Taylor, Fichter Steel Construction Co., treasurer. J. L. Hay, Hay Foundry & Iron Works, has been made chairman of the finance committee. The Board of Directors consists of the foregoing officers, Mr. Eidlitz and A. M. Conneen, Jr., Hedden Iron Construction Co., L. D. Rights, Shoemaker Bridge Co., and R. T. Brooks, George A. Just Co.

Business Notes

JOHN MCNEILLY, for ten years associated with the Beckwith Machinery Co., Pittsburgh, as a director, has recently established an agency bearing his own name in Columbus, Ohio. Mr. McNeilly will handle used construction equipment, acting as distributor for a number of well-known manufacturers.

R. L. M. TAYLOR has recently been appointed district sales representative of the New York and eastern Pennsylvania territory of the Reading Iron Co. Mr. Taylor has been with the Reading company for one year, previous to which he was for five years connected with the A. M. Byers Co.

BUCYRUS CO., South Milwaukee, Wis., announces the opening of a new sales office in Pittsburgh, Pa., in charge of A. R. Hance, formerly northwestern sales manager. Mr. Hance's territory will include Ohio, western New York, western Pennsylvania, western Maryland, West Virginia, and eastern Kentucky.

THE DURIRON CO., INC., Dayton, Ohio, announces the appointment of the following representatives who will sell its drain pipe, fittings and laboratory equipment: Rex W. Williams, Salt Lake City, Utah; Sullivan Valve & Engineering Co., Butte, Mont.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa., announces the following appointments of four new street lighting engineers: C. F. Pearson, Jacksonville, Fla.; I. B. Boyer, Dallas, Tex.; L. F. Watson, Los Angeles, Calif.; H. W. Lingenfelter, Chicago, Ill. Announcement is also made that William A. Rossel has been appointed manager of the central division of the New York office.

Equipment and Materials

Motor-Truck Attachment Bores Holes, Places and Pulls Poles

A new attachment manufactured by the Four Wheel Drive Auto Co., Clintonville, Wis., for use on its motor trucks, is equipment for earth boring and pole setting. The equipment consists essentially of a tower, boom and auger, operated from a special power take-off attached to the rear of the transmission of the truck. The power from the take-off is transmitted through two sets of bevel gears mounted on two taper roller bearings which are adjustable from the outside. Gears run in cast-steel oil and dust-proof housings in a constant bath of oil. The main shaft is nikrome steel and is mounted on two shelf aligning double-row heavy duty type ball bearings. The countershaft is mounted in the same manner.

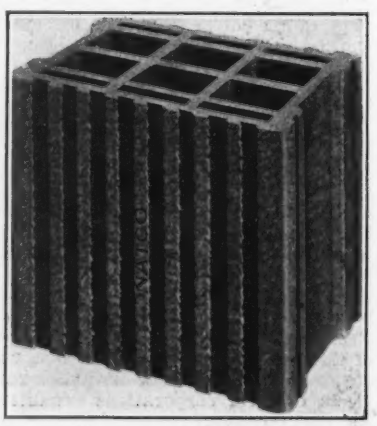
The power to the auger is transmitted by a 1¼-in. pitch roller chain. Total speed reduction from the motor to the auger is 11.4 to 1 in high; 22.8 on second, and 45.6 on low speed. The tower can be furnished in various lengths from 6 to 26 ft. long. The boom is hinged on a pivot shaft on top of the tower and can be adjusted upward or downward a distance of 32 in. from the top of the tower. It is made of 5-lb. channels, extends out 3 ft. from the rear of the tower when in working position, and is raised and lowered by means of a hand crank. The augers are all made of special cast steel, and are available in various sizes from 15 in. to 48 in. A winch mounted on the front end of the earth boring machine has a lifting capacity of 4,000 lb. and is used in connection with the standard boom or special derrick in the pulling or setting of poles.

Three men are necessary to operate this machine. The auger has a circle swing of 180 deg., and may be inclined to bore holes at various angles to the perpendicular. By using a 1¾-in. drill

attached to the auger shaft, holes may be bored in solid rock at the rate of about 1 in. per minute. These small holes may be shot with dynamite and then cleaned out with a larger auger. As a safety factor, truck and boring machine cannot be operated at the same time. By the removal of six bolts, the complete earth-boring equipment may be removed from the truck, thus releasing it for other purposes.

New Load-Bearing Tile Has Double Walls

A new tile for building purposes is known as the Nacto double shell load-bearing tile and is manufactured by the National Fire Proofing Co., Pittsburgh, Pa. The tile is made with 12x12-in. face walls 6, 8, 10 and 12 in. thick. One 8x12x12 tile is equivalent to 14 bricks in an ordinary 8-in. wall. Both interior and exterior faces are dovetailed for stucco and plaster. The



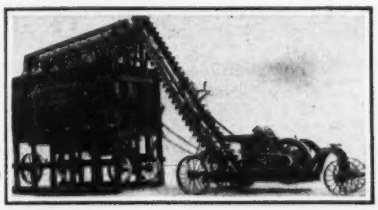
dovetailed feature is claimed to result in a very efficient bond.

Still air spaces in every tile provide insulation against rapid changes in temperature, thus eliminating the necessity of any furring and lathing. The mortar does not extend entirely through the wall of the joints, so that there is no passage of moisture through the wall. The wide double shells make good mortar joints both in the vertical and horiztonal directions. They also facilitate the installation of pipes, conduits and wiring. No cutting of tile is claimed to be necessary since half lengths are furnished.

Portable Crushing Plant

The Climax rock crushing plant manufactured by the Good Roads Machinery Co., Kennett Square, Pa., consists of a crusher, mounting, elevator, revolving screen, and portable stone bin. It represents a complete unit for the production of crushed stone in all sizes suitable for street and road work.

The crusher is made in two sizes, the smaller machine having a receiving opening 9 x 16 in. with a capacity of about 100 tons per day; the larger



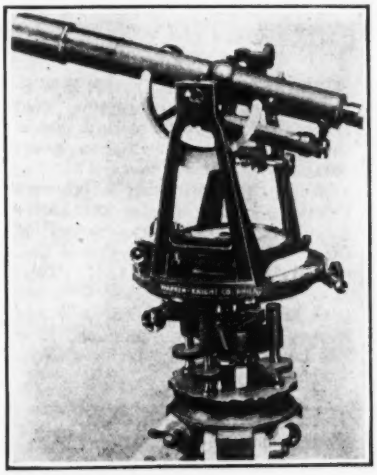
size has a receiving opening 10 x 20 in. with a capacity of about 150 tons per day. The crusher is of the jaw type, eccentric driven, with a cast steel frame.

The mounting consists of steel I-beam sills, carried on four steel wheels. The elevator is of the folding type so that the top half can be laid down over the crusher when it is desired to move the outfit on the road. The elevator buckets are of steel.

The screen is gear driven, with a shaft running all the way through. It is furnished in either 30- or 36-in. diameter, depending on the products to be handled. It may be punched with any size holes that may be specified. Steel chutes are attached to both sides so that the stone can be delivered from either or both sides of the bin. Bins are made in 20, 25, 30, and 40-ton capacities.

New Precision Transit of Sturdy Construction

The new "Sterling" precision transit just brought out by Warren-Knight Co., Philadelphia, embodies several new features of construction which are claimed to give the transit accurate and permanent adjustment under rough usage. The bronze standards are combined with a special system of top plate ribbing designed to act as a single unit. Cylindrical bearings carry the telescope axle whose adjustment is effected by the use of opposing capstan nuts. The telescope is 11⅛ in. long with disappearing stadia arrangement permitting cross wires to be focused with or without the stadia. This horizontal limb is 6¼ in. diameter at graduated edge,

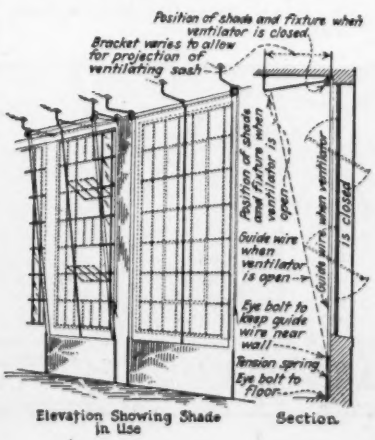


numbered 0 deg. to 360 deg. on silver; double verniers located at 30 deg. to the line of sight read to single minutes.

The vertical arc is of 180-deg. type reading by double vernier to single minutes. The compass is graduated in quadrants with the figures slanted to indicate the direction of reading. The center is of extra large diameter and 7 deg. taper; materials used are bell metal for inside center, phosphor bronze for the middle center, and bronze for the leveling head. Tangent clamp screws are provided with opposing springs and adjustment for taking up the wear. The weight of the transit is 16 lb. The tripod of spruce weighs 11 lb.

Industrial Window Shade Does Not Retard Ventilation

A complete window shade for industrial buildings that will cover an opening up to 12 ft. wide and operates in conjunction with pivoted steel sash so as not to retard ventilation when the windows are open, is a product of Wm. Blanchard Co., 233 Friend St., Boston. The shade material is a soft cotton


Position of shade and fixture when ventilator is closed.
Bracket varies to allow for projection of ventilating sash
Position of shade and fixture when ventilator is open
Guide wire when ventilator is open
Guide wire when ventilator is closed
Eye bolt to keep guide wire near wall
Tension spring
Eye bolt to floor
Elevation Showing Shade in Use
Section.

fabric that eliminates glare and diffuses sunlight; it is furnished in white or light brown. The shade cloth is mounted on a springless ball bearing roller suspended from a bracket attached to the building as shown in the illustration.

When the sash is closed, the shade operates close to the window; upon opening the sash, the release of a cord permits the roller to automatically travel to a position that permits the shade to pass the open ventilator without catching. Cable guides that are always on tension prevent the shade from blowing about. For sash that is over 12 ft. wide a double shade, lapped at the center to avoid side lights, is used.

Concrete Telephone Poles Made by Centrifugal Process

The new "Hollowspun" concrete poles manufactured by the Westinghouse Electric & Mfg. Co., are made by revolving the horizontal form containing the reinforcing cage, at the same time inserting the concrete mix which spreads itself by the centrifugal force developed. There is a cylindrical opening left in the center running the entire length of the pole.

Steps, crossarms and other attachments may be applied to the poles. The use of these poles is claimed to make possible a considerable increase in the capacity of the lines, and thus permits the reduction of the number of poles per mile or an increase in the number of wires without reducing the factor of safety.

Publications from the Construction Industry

Floor Surfacing—ELECTRIC ROTARY MACHINE CO., Chicago, describes in a new catalog its "Free-O-Dust" machine, which is a combination abrasive machine and vacuum cleaner. Details of construction and illustrations are also given.

Road Graders—GOOD ROADS MACHINERY CO., INC., Kennett Square, Pa., has issued an 11 p. booklet describing with text and photos its "Standard" and "Jumbo" steel reversible road graders.

Gravel Plants—LINK-BELT CO., Chicago, has published a 72 p. catalog known as Book No. 540 devoted exclusively to plants for washing sand and gravel. The illustrations and text set forth all the various details of the plants. Twenty pages of the book are devoted to typical illustrations of Link-Belt equipment in use in sand and gravel plants in various parts of the United States.

Car-Puller — MEAD-MORRISON MFG. CO., East Boston, Mass., in its new bulletin No. 129, describes its electric capstan car-puller. A long list of typical installations is included in the catalog.

Engineering News-Record Statistics of the Construction Industry

September 3, 1925 — *in the United States* — Vol. 95, No. 10

Engineering News-Record CONSTRUCTION COST Index Number (1913 = 100)

MONTHLY

January, 1924 to Date

September, 1925	**202.10**
August, 1925	204.60
September, 1924	211.25
Peak, June, 1920	273.80
1913	100.00

1924

Jan.	217.90	May	222.33	Sept.	211.25
Feb.	220.30	June	216.85	Oct.	207.55
March	224.60	July	214.40	Nov.	205.70
April	221.60	August	213.15	Dec.	208.58

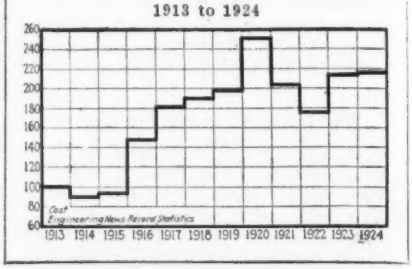
1925

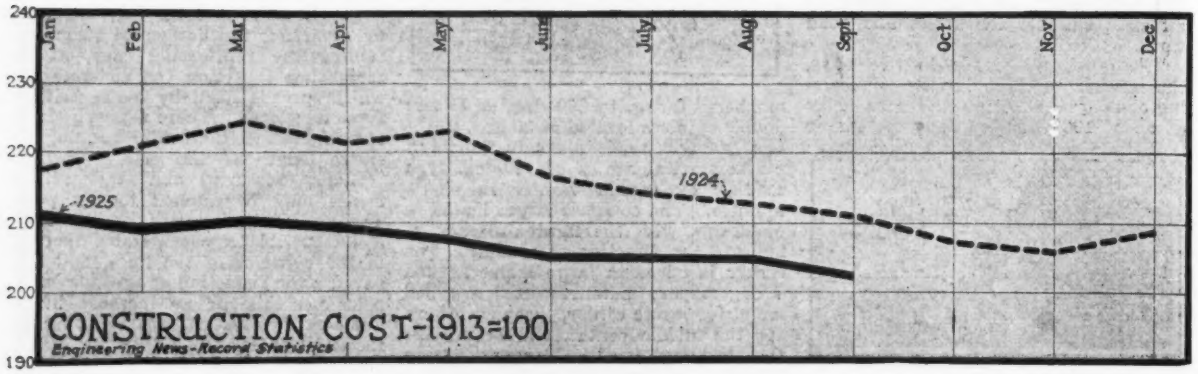
Jan.	210.40	May	207.20
Feb.	209.70	June	204.60
March	210.20	July	204.60
April	209.50	August	204.60

ENGINEERING NEWS-RECORD'S Construction Cost Index Number is 2.5 points below the August level, owing to lower cost of structural material. The average rate for common laborers is still 53c. per hr. for the entire country. The same rate prevailed three months ago as against 56c. per hr. in September, 1924. Thus general construction cost is 4 per cent lower than one year ago and 26 per cent under the peak; it is 102 per cent above the 1913 level.

YEARLY

1913 to 1924





Engineering News-Record CONSTRUCTION VOLUME Index Number (1913 = 100)

MONTHLY

January, 1924 to August, 1925

August, 1925	**266**
July, 1925	178
August, 1924	162
Peak, May, 1922	221
1913	100

1924

January	125	May	194	September	159
February	144	June	149	October	164
March	161	July	161	November	128
April	159	August	162	December	145

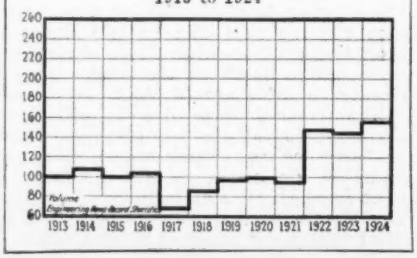
1925

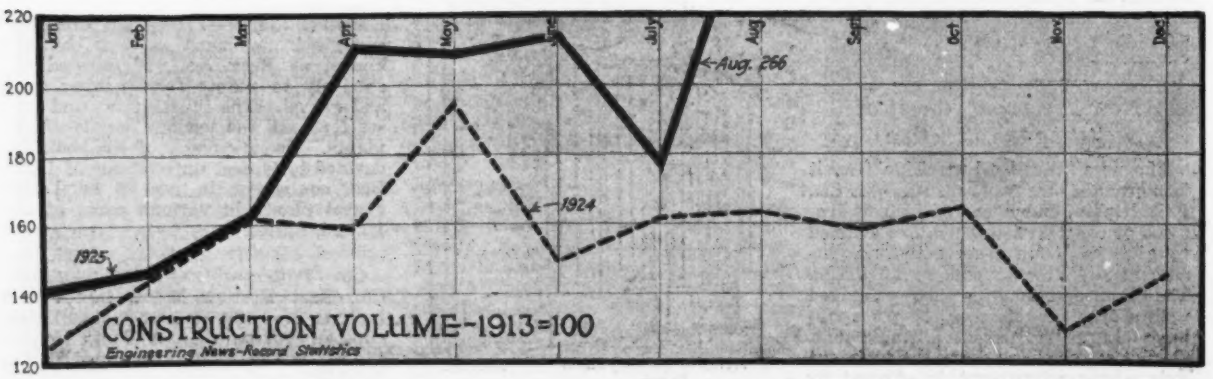
January	141	April	211
February	145	May	209
March	161	June	214

ENGINEERING NEWS-RECORD'S Construction Volume Index Number is 266 for the month of August, and 154 for the whole of 1924, as against 100 for 1913. This means that the actual volume of construction in 1924 (not the mere money-value of the contracts let that year) is 54 per cent above the volume of construction for 1913. The monthly volume number, 266 for August, 1925, contains the increment of construction and indicates the rate at which contracts are being let as compared with 1913 awards.

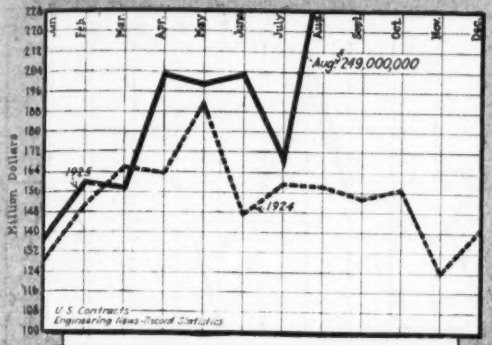
YEARLY

1913 to 1924

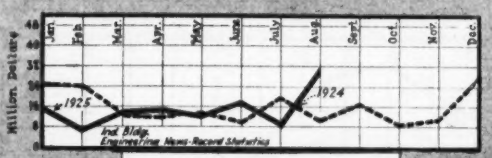




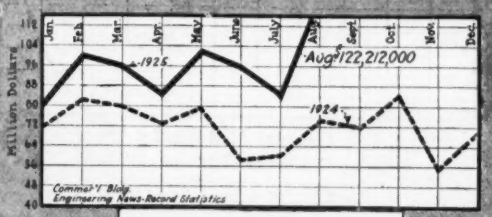
Monthly Statistics of the Construction Industry



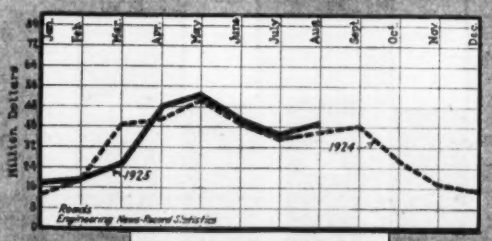
Contracts Awarded in the United States
Reported in E. N. R.



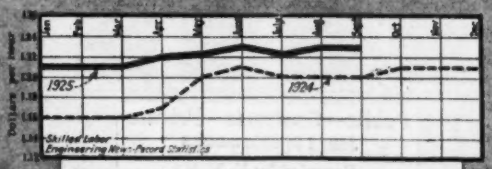
Industrial Building Awards
$40,000 and Over



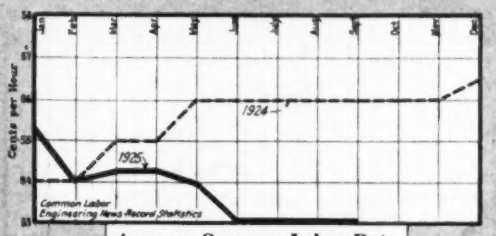
Commercial Building Awards
$150,000 and Over



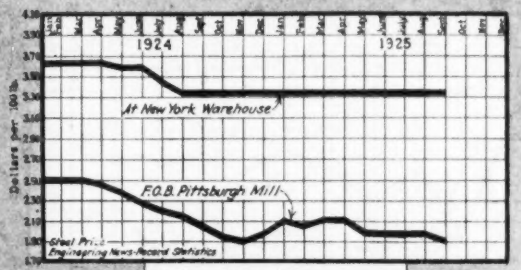
Street and Road Lettings
$25,000 and Over



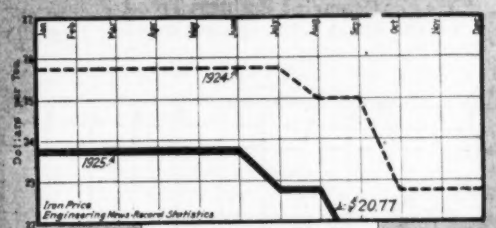
Average Wage of Skilled Building Trades
Bricklayers, Carpenters and Steel Erectors



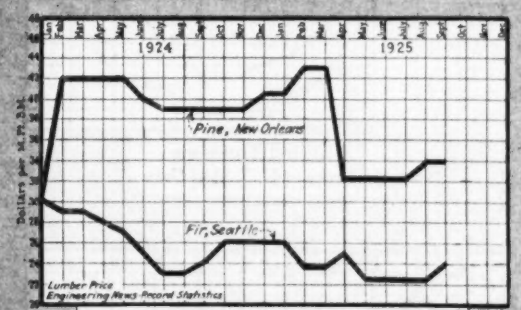
Average Common Labor Rate
Pick and Shovel Men



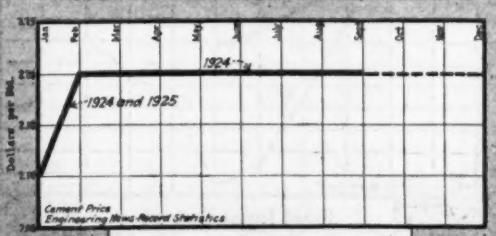
Price of Steel Structurals
Shapes 3-In.; Plates ¼-In.



Price of Basic Pig Iron
F.o.b. Pittsburgh

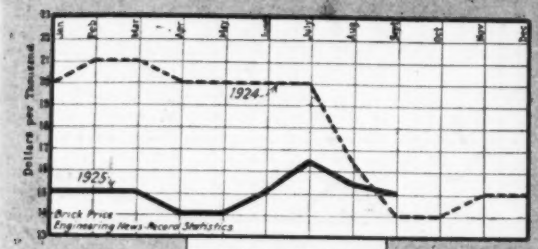


Price of Timbers, Wholesale, Base Sizes
Car Lots to Contractors

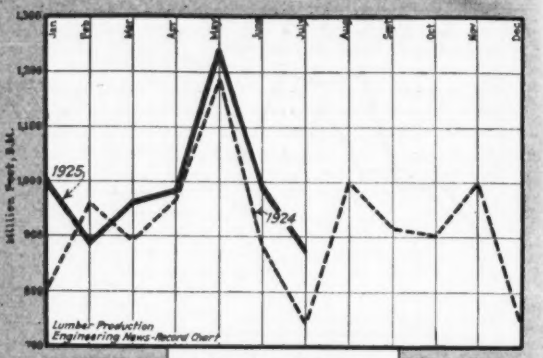


Net Price of Portland Cement
Car Lots, F.o.b. Chicago

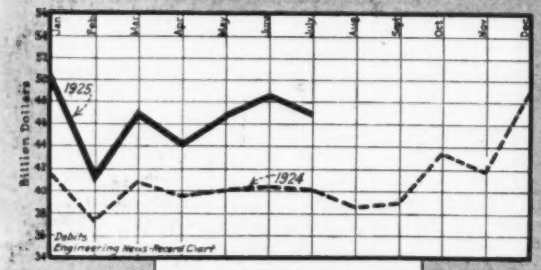
Monthly Statistics of the Construction Industry



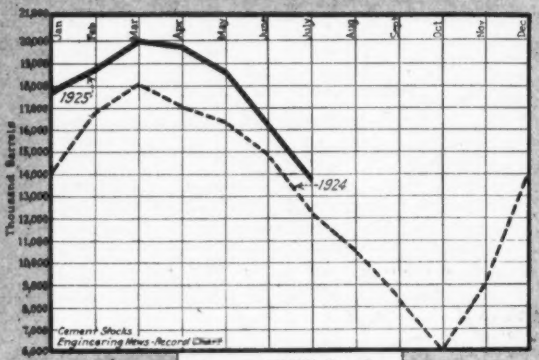
Price of Brick
At Dock, New York



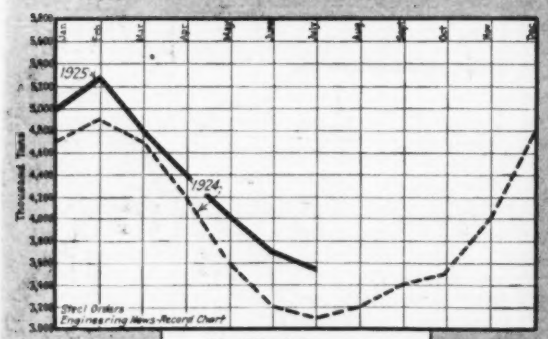
Lumber Output
Nat. Lumber Mfrs. Assn.



General Business Trend
Bank Debits—Federal Reserve

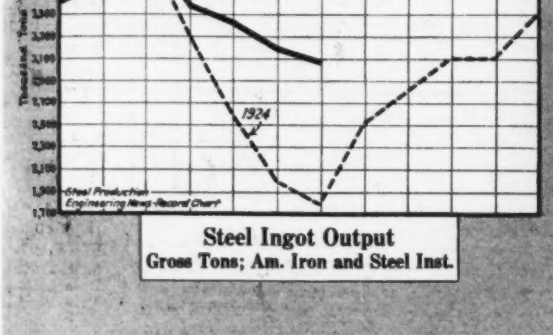


Cement Mill Stocks
Geological Survey



Unfilled Tonnage
On Books of U. S. Steel Corp.

Public—Contracts—Private
Jan. 1 to date
Reported by E. N.-R.



Steel Ingot Output
Gross Tons; Am. Iron and Steel Inst.

August Contracts Reach Record Total for That Month—This Year to Date 16 Per Cent Ahead of Last

A RECORD for the month of August has just been established in money value of large engineering construction contracts awarded.

Taking a minimum of $15,000 on waterworks and excavations; $25,000 on other public works; $40,000 on industrial buildings and $150,000 on buildings of a commercial type, the August total aggregated $249,231,000 for the entire United States.

Contract letting gained during August over the month preceding in every classification except excavation. Awards from Jan. 1 to date, compared with the same period last year, show expansion of construction demand in all sections of the country except the Middle West. The Florida real estate boom, while it has not swelled the total of engineering construction for that section, has started to draw heavy shipments of building materials toward the South.

The following tabulation shows August totals, at the above minimum in each class, for the past thirteen years:

1913	$37,571,000	1920	$91,799,000
1914	49,427,000	1921	100,784,000
1915	54,352,000	1922*	147,588,000
1916*	99,765,000	1923*	128,157,000
1917*	68,926,000	1924	158,385,000
1918*	124,829,000	1925	249,231,000
1919	126,814,000	* Five issues *E. N.-R.*	

The six largest projects awarded during the month were: (1) An office building, New York, N. Y., to Todd, Robertson & Todd Engineering Corp., $29,000,000; (2) power plant, Bagnell, Mo., to Bickel Constr. Co., Kansas City, Mo., $12,000,000; (3) electric generating plant, Cleveland, O., to Hunkin-Conkey Constr. Co., $10,000,000; (4) roads, 1,800-mi., Mexico City, Mexico, to Byrne Bros. Constr. Co., Chicago, $12,000,000; (5) subway, Philadelphia, Pa., to Patrick McGovern, Inc., $11,498,032; (6) office building, New York, N. Y., Fred F. French, $10,000,000.

With construction, Jan. 1 to date, nearly 16 per cent ahead of the corresponding period in 1924, a record year is expected for 1925. The total for the current year will, it is estimated by *Engineering News-Record*, reach $6,629,000,000 as against $6,012,000,000 for 1924.

Value of Contracts Let in the United States and Canada, August, 1925

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Far West	United States	U. S. Jan. 1 to Sept. 1	Canada
Waterworks	$192,000	$474,000	$981,000	$725,000	$2,863,000	$209,000	$5,435,000	**$43,612,000**	$335,000
Sewers	33,000	6,878,000	518,000	1,910,000	3,964,000	681,000	13,984,000	**54,790,000**	1,154,000
Bridges	116,000	1,002,000	2,189,000	2,577,000	715,000	523,000	7,122,000	**45,777,000**	153,000
Excavation, dredging, etc.		223,000	35,000	162,000	357,000	47,000	824,000	**8,740,000**	2,560,000
Streets and roads	2,382,000	8,458,000	8,913,000	13,179,000	4,763,000	3,504,000	41,199,000	**310,562,000**	2,080,000
Industrial building	1,430,000	1,352,000	80,000	14,307,000	12,755,000	901,000	30,825,000	**131,618,000**	2,347,000
Commercial building	11,614,000	68,648,000	9,493,000	14,143,000	12,652,000	5,660,000	122,212,000	**829,360,000**	432,000
Federal government	456,000	915,000	371,000	46,000	112,000	617,000	2,517,000	**24,740,000**	
Unclassified	144,000	16,331,000	670,000	300,000	7,518,000	150,000	25,113,000	**156,623,000**	2,420,000
Aug., 1925	$16,367,000	$104,281,000	$23,252,000	$47,349,000	$45,699,000	$12,283,000	$249,231,000	**$1,605,822,000**	$11,421,000
Aug., 1924	15,231,000	25,636,000	15,789,000	40,611,000	34,320,000	26,798,000	158,385,000		4,907,000
July, 1925	14,446,000	78,340,000	12,264,000	39,549,000	35,506,000	31,988,000	212,093,000		7,574,000
1925, Jan. 1 to Sept. 1	**130,826,000**	**569,811,000**	**132,705,000**	**289,903,000**	**291,302,000**	**191,275,000**	**1,605,822,000**		**59,245,000**
1924, Jan. 1 to Sept. 1	91,805,000	417,842,000	161,223,000	301,648,000	225,917,000	186,259,000	1,384,694,000		65,070,000

Labor Rates and Conditions Throughout the Country

RECORD achievements in construction contract letting, bank debits, freight loadings, municipal bond sales, production and shipment of cement, justify the present expectations of expansion in Autumn trade.

Some of the factors exerting a strong influence in this direction are: gain in projected building over that of a year ago, particularly in the Eastern and Southern states; increased lumber output and demand; heavier brick demand and supply; recent slowness of trade attributable to nothing more serious than seasonal mid-summer decline; notable improvement in the agricultural outlook; active retail trade; exports at comparatively high levels; little fluctuation in money rates.

Certain unfavorable developments continue to cloud the situation, they are: unemployment trifle above normal for this time of the year; adverse foreign conditions; advance in wholesale prices, principally foodstuffs, chemicals, drugs, and clothing; pending wage controversy affecting railway brotherhoods; jurisdictional dispute between bricklayers and plasterers; movement of certain Western railroads in the direction of higher freight rates; demand for freight rate reduction on the part of the farmers; wage reduction of 10 per cent in New England woolen and worsted mills; wage decrease in rubber tire industry; steadily declining steel output since March, 1925; gold exports in excess of imports; the coal miners' strike.

In view of a favorable general outlook, the situation, locally, in several important industrial centers, is given as follows:

Baltimore—Dispute over adoption of union wage scale for employees of City of Baltimore has been submitted to board of arbitration. Both labor leaders and city officials have agreed to this method of settling the controversy.

Birmingham — Much construction is now under way in this district. There are few unemployed and first class mechanics are in good demand.

Boston—Strike in building trades avoided by acceptance on all sides of terms proposed by representatives of employers and labor unions at recent conference.

Chicago—Scarcity of bricklayers and plasterers reported. Non-union common laborers especially plentiful at this time.

Cincinnati — Granting of wage increase of $2 per week to union truck drivers averted a transportation tie-up in this city. Present agreement will terminate in 1928.

Dallas — Recent influx of foreign steel in this section of the country has ceased to affect the local market. Fabricators in this territory are now buying at domestic mills.

Detroit—Residential and other small building construction has slackened during the past month. Large supply dealers in Detroit have reduced prices of materials, delivered at site of job, below levels of a month ago. There has been no change, however, in carload prices. The result of this action is a satisfactory volume of business in this territory, with contractors receiving the the benefit of the price reductions.

Montreal — Unemployment situation much improved despite surplus of non-union common laborers. Building permits issued in sixty large cities of Canada during first half of 1925, increased 8 per cent over the corresponding period last year.

New Orleans—No trouble is anticipated in this section as a result of the dispute between bricklayers and plasterers pending in several of the other large cities of the country. These trades in New Orleans are controlled exclusively by colored laborers.

New York — Electrical workers' demand for an advance of $1.50 per day is being resisted by employers. It is suggested that other building trades may follow lead of electricians and demand higher rates for the 1926 season. The jurisdictional dispute between the Operative Plasterers and Cement Finishers' International Association and the Bricklayers, Masons and Plasterers' International Union is still raging, with little possibility of settlement until the A. F. of L. convention in Atlantic City in October. The feud arose, in the first place, over the employment of plasterers from one union in territory claimed by the other and has little to do with the employers. It is reported, however, that Long Island bricklayers and the masons, bricklayers, carpenters and ironworkers who went on sympathetic strike in Northern New Jersey have all returned to work.

Current Building Trades Wage Rates Per Hour

(Higher rates indicated by +, decreases by —)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1 12½	$0 70	$0 70	$0 50	.....	$0 75	$0 25@ 30
Baltimore	1 50@1 75	1 00@1 20	1 00@1 12½	1 00	$0 65	1 12½	40
Birmingham	1 00@1 50	.35@ 87½	.75@1 25	.50@ 75	.....	.75@1 75	.20@ 40
Boston	1 25	1 10	1 10@1 30	.70@ 75	1 10	1 10	.50@ 75
Cincinnati	1 50	1 25	1 25	.92½	1 25	1 25	40@55
Chicago	1 50	1 37½	1 37½	.87½	1 37½	1 37½	.82½@ 87½
Cleveland	1 50	1 25	1 30	.87½	1 00	1 50	.87½
Dallas	+1 62½	1 12½	+1 12½	.40@ 75	.87½	+1 12½	.30@ 50
Denver	1 62½	1 12½	1 12½@1 18¾	.81¼@ 87½	1 00	1 15¾	.35@ 55
Detroit	1 50	.70@1 00	.85@1 00	.90	.85@1 00	1 12½	.50@ 60
Kansas City	1 37½	+1.25	—1.00@1.25	.90	—1 12½	+1.12½@1 25	+ 35@ 75
Los Angeles	1 25	.87½	.75	.75	.75	.87½	.50
Minneapolis	1 12½	.87½	.87½	.71½	.....	.87½	.50@ 55
Montreal	.90	.45@ 65	.62½	.30@ 35	.50	.65	+ 25@ 35
New Orleans	1.25	.90	1 00	.65	.85	1.25	.35@ 40
New York	1 50	1 31¼	1 50	1 00	1 00@1 12½	1 50	.55@ 75
Philadelphia	1 50	1 12½	1 02½	1 12½	1 00	1 12½@1.25	.45@ 50
Pittsburgh	1 62½	1 37½	1 37½@1 43¾	1 00	.....	1 43¾	— 70
St. Louis	1.75	1 50	1 50@1.65	1.15@1.25	1 50	1.50	+.45@ 87½
San Francisco	1 25	1 00	1 00	.81¼	1 00	1 12½	.50@ 55
Seattle	1 37½	1 12½	1 00@1 12½	1 00	1 00@1 12½	1 12½	.50@ 62½

Philadelphia — Volume of general construction is below a year ago; considerable improvement noted in industrial building. Demand for carpenters is especially keen. Labor troubles are being experienced between employers and hoisting engineers, cement finishers, tile workers, and plumbers. Union plumbers demand closed shop.

Pittsburgh — Stone cutters granted rise of 6¼c.; hod carriers, 9¾c. per hr.

St. Louis—Journeymen plumbers demand advance of $2 per day above present rate of $12. Strike voted to begin Sept. 1. Employers claim that journeymen are bound by contract which does not expire until Feb. 3, 1926.

San Francisco—Building trades continue active in Bay region.

Seattle — Public improvement continues active and is expected to extend well into fall months. Lessening of forest fire hazard and depletion of log stocks in the water tend toward renewed activity in western Washington lumber camps.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Considerable pig iron is accumulating on the Birmingham yards; practically all furnaces in this district are operating. Most of the price changes of the month were in a downward direction. The market is below a year ago at New York, Philadelphia, Chicago (No. 2 F'dry So.) and Pittsburgh.

Railway Supplies — Light rails in light demand; price trend downward. Standard rails remain firm at last year's levels. Ties are lower than a month ago in the St. Louis district; fluctuations in track bolts and angle bars also reported.

Pipe—Steel pipe prices remain firm and unchanged. Cast-iron pipe is higher in Birmingham and Seattle and slightly below a month ago in Pittsburgh and Chicago. Sewer pipe is tending downward in Boston, Minneapolis, Atlanta and Kansas City, Mo.

Road and Paving Materials — The majority of changes in asphalt prices during the month were downward, while in road oils the opposite condition prevailed. The tendency is upward in paving stone and wood blocks.

Sand, Gravel and Crushed Stone—Of twenty-one cities reporting regularly to E. N.-R., only three register any changes in the market for aggregates, these are all advances, as follows: gravel in Atlanta; sand, in Birmingham and Atlanta; crushed stone, in Chicago and Atlanta.

THE present lower cost of construction, compared with this period in 1924, is due entirely to reduction in materials' prices, since labor rates in the building trades remain practically the same. With steel structurals 10c. per 100 lb. below and lumber $1 per M. ft. above their respective levels of a year ago, it is seen that frame buildings are more expensive, while concrete and steel construction is cheaper than at this time last year. Cement prices have retained their usual stability and aggregates have fluctuated but slightly during the past year.

Lime and Cement—Lime is higher in St. Louis, Chicago and Philadelphia and down in Boston and Montreal. All of the advances were in lump lime. Natural cement took a rise during the month in Kansas City, Boston and St. Louis. In portland cement, the only change in forty-six districts reporting, was a slight adjustment downward at Atlanta dealers' warehouses.

Brick and Hollow Tile — Common brick rose $2 per M in Kansas City, Mo. and paving brick (4-in.) $1 in Boston during the month. Common brick dropped 50c. in New York and $1 in Baltimore at the same time. Tile is firmer in the South, with a down-trend in Boston, St. Louis and Montreal.

Structural Steel—Mill operations are gaining each week over the one preceding. Present rate is about 70 per cent of capacity. Steel bars and wire products are most active in the current market, although price of former is 10c. per 100 lb. below the August level. Structurals are $1.90 to $2 per 100 lb., Pittsburgh, against $1.85@$2, last month. Sales were reported during latter part of August, as low as $1.80 per 100 lb. at mill. Minimum on reinforcing bars is $1.90, compared with $2 per 100 lb. one month ago.

Lumber — Demand and output is heavier than at this time last year. Northwest fir is firmer and much improvement is noted in the yellow pine market. Pine buying is particularly good in boards, lath, upper grades of flooring, timbers and special cuttings.

Iron and Steel Scrap — Prices are higher than last month in New York and Chicago. The Birmingham market, however, shows no change.

Miscellaneous — A decidedly upward trend is noted in prices of roofing materials, linseed oil and manilla rope.

E. N.-R. Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton f.o.b.:

	Sept. 3	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25@2.75)	$23.05	$22.05@22.55
Northern Basic	22.27	20.00
Southern Ohio No. 2 (silicon 1.75@2.25)	22.77	21.77
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25@2.75)	27.37	28.05
BIRMINGHAM		
No. 2 Foundry (silicon 2.25@2.75)	*18.50*	18.00
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	*22.26*	22.77@23.27
Virginia No. 2 (silicon 2.25@2.75)	29.17	28.44@29.44
Basic	*21.16*	20.00@21.00
Gray Forge		21.00@22.00
CHICAGO		
No. 2 Foundry Local (silicon 1.75@2.25)	22.00	20.00
No. 2 Foundry Southern (silicon 2.25@2.75)	25.55	28.05
PITTSBURGH, including freight charge ($1.76) from the Valley		
No. 2 Foundry Valley (silicon 1.75@2.25)	*20.77*	25.00
Basic	*20.77*	25.00
Bessemer	*20.77*	28.66

SCRAP—The prices following are f.o.b., per gross ton paid to dealers and producers:

	New York	Chicago	Birmingham
No. 1 railroad wrought	$14.00@$14.50	$16.75@$17.25*	$12.00@$13.00
Stove plate	10.50@12.00	15.50@16.00*	13.00@13.50
No. 1 machinery cast	17.50@18.00	18.00@18.50*	16.00@16.50
Machine shop turnings	9.25@10.00	10.50@11.00	7.00@8.00
Cast borings	9.50@10.00	13.50@14.00	7.00@8.00
Railroad malleable	15.00@15.50	19.50@20.00	17.00@18.00
Re-rolling rails	14.25@14.75	19.50@20.00	16.50@17.00
Re-laying rails	23.00@24.00	25.00@26.00	21.00@22.00
Heavy melting steel	11.75@13.75	16.75@17.00	13.00@14.00

*Net ton.

Railway Supplies

STEEL RAILS—The following quotations are per ton f.o.b. for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	Sept. 3	One Year Ago	Birmingham	Chicago*	St. Louis
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00	$47@49
Standard openhearth rails	43.00	43.00	43.00	43.00	*49@50*
Light rails, 8 to 10 lb.	32@34	37@38	34@36	1.80@1.90	
Light rails, 12 to 14 lb.	*32@34*	37@38	34@36	1.80@1.90	*1.90@1.95**
Light rails, 25 to 45 lb.	*32@34*	37@38	34@36	1.80@1.90	*1.85@1.90**
Re-rolled rails	27@30	27@35	.....	.....	18.50

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, white oak, plain	$1.40	$1.75
Chicago, empty cell creosoted	1.75	2.10
Chicago, zinc treated	1.55	1.90
San Francisco, green Douglas fir	.84	1.14
San Francisco, empty cell creosoted, Douglas fir	1.70	2.25
St. Louis, white oak, plain	*1.00*	*1.25*
St. Louis, zinc treated	*1.40*	*1.60*
St. Louis, red oak, plain	.90	*1.15*
St. Louis, sap pine-cypress	*.75*	*1.00*
Birmingham, white oak	1.25	1.45

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh mill for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	Sept. 3	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$2.80	$2.80	$3.55	$3.65	$4.35	$2.90
Track bolts	3.90@4.15	3.75	4.55	*3.25*	5.85	3.90
Standard section angle bars	2.75	2.75	3.30	3.25@3.75	4.00	3.85

Pipe

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
1 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
10 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

STEEL PIPE—From warehouses at the places named the following discounts hold for welded steel pipe:

	Black			
	New York	Chicago	Birmingham	St. Louis
1 to 3 in. butt welded	53%	54%	62%	49%
3½ to 6 in. lap welded	48%	51%	59%	46%
	Galvanized			
	New York	Chicago	Birmingham	St. Louis
1 to 3 in. butt welded	39%	41%	50%	36%
3½ to 6 in. lap welded	35%	38%	47½%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36—5% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham	Pittsburgh	New York	
			Sept. 3	One Year Ago
4 in.	$45.00	*$53.20@*54.20	$55.60@56.60	$65.60@66.60
6 in. and over	40.00@42.00	*49.20@*50.20	50.60@51.60	60.60@61.60

	Chicago	St. Louis	San Francisco
4 in.	*$53.20@*54.20	$51.60	$56.00
6 in. and over	*49.20@*50.20	47.60	52.00

Gas pipe and Class "A," $4 per ton extra.

CLAY DRAIN TILE—The following prices are per 1,000 lin.ft.:

Size, In.	New York Sept. 3	New York One Year Ago	St. Louis	Birmingham	San Francisco	Dallas
3	$48.00	$45.00	$40.00	$45.00	.....	$73.00
4	50.00	55.00	40.00	56.00	$76.50	110.00
5	70.00	80.00	.....	80.00	97.75	118.00
6	92.00	105.00	70.00	100.00	127.50	150.00
8	160.00	170.00	170.00	165.00	212.50	210.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	$0.081	$0.10	.....	$0.09	$0.12	.....
4	.....	.081	.10	$0.10	.09	.15	$0.15
5	.....	.1215	.135	.....	.13½	.18	.18
6	$0.21	.1215	.135	.14	.13½	.21	.21
8	.35	.189	.21	.225	.21	.30	.325
10	.52	.2835	.315	.315	.31½	.42	.476
12	.66	.3645	.45	.405†	.40½	.56	.612
15	1.14†	.486	.54	.675†	.54	.92	1.02
18	1.65†	.675	.75	.945†	.75	1.32	1.53
20	1.98†	.81	.90	1.26†	.90	.....	.....
22	2.65†	1.08	1.20	.....	1.20	.....	1.564
24	2.97†	1.215	1.35	1.62†	1.35	2.16	2.04
27	4.65†	2.405	2.665	2.45†	2.25	3.00	3.34
30	5.16†	2.664	2.952	3.00†	3.75	3.60	4.06
33	6.98†	3.60	3.96	3.55†	4.50	.....	4.99
36	8.00†	4.10	4.51	3.95†	5.00	.....	5.42

	3	5	8	12	24	36
Boston	$0.13	*$0.195*	$0.30	$0.60	$2.00†	$5.50†
Minneapolis	.....	.....	*.225*	*.405*	*1.35*	*4.75*
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.14	.....	.35	.72†	2.60†	.....
Los Angeles	.1625	.195	.275	.495	1.65	.....
New Orleans	.115*	.117*	.295	.4725	1.575	.....
Cincinnati	.105	.1575	.245	.4725	1.575	4.715
Atlanta	*.09**	*.135**	*.225*	*.3825*	*1.4825*	.....
Montreal	.68‡	.45†	.70	1.35	4.50†	.....
Detroit	.07	.1125	.175	.3375	1.935†	5.6375†
Baltimore	.111	.166	.259	.499	1.665	4.92
Kansas City, Mo.	.15*	.21	*.32*	*.52*	.....	.....
Philadelphia	.12	.18	.28	.54	1.80	4.60

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

Road and Paving Materials

ROAD OILS—Following are prices per gallon in tank cars, 8,000 gal. minimum f.o.b. place named:

		Sept. 3	One Year Ago
New York, 45% asphalt	(at terminal)	‡0.065@$0.07	$0.055
New York, 65% asphalt	(at terminal)	.0675@.0725	.06
New York, binder	(at terminal)	.07 @ .075	.065
New York, flux	(at terminal)	.07 @ .075	.04
New York, liquid asphalt	(at terminal)	.07 @ .075	.06
St. Louis, 40@50% asphalt		.05	.0475
St. Louis, 50@60% asphalt		*.051*	.0481
Birmingham 55% asphalt		.0475	
Dallas, 45% asphalt		.05	.0495
Dallas, 55% asphalt		.046	.0455
Dallas, binder		.062	.061
San Francisco, binder, per ton		13.50*	11.00*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

E. N.-R. Prices of Construction Materials

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$23 50*	$19.50
Boston (*Mexican*)	22.50	18.00
Chicago (*Texas*)	27 00	*23 00*
San Francisco, *f.o.b. refinery*, Oleum, Cal.	19.50	13.50
Dallas (*Texas*)	27.10	21.10
Seattle, *"D" grade, California, f.o.b. Richmond*	19.50	13.50
Denver (*California*)	24 00	....
Minneapolis, *f.o.b. Twin Cities* (*Stanolind*)	**27.60**	**21.60**
St. Louis (*Mexican*)	*25.00*	*21.00*
Baltimore (*Mexican*) (*f. o. b. refinery*)	22 50	18.50
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	26.10	21.90
Detroit (*Mexican*)	27.00	23.00
Cincinnati (*Kentucky Rock*)	....	11.65
Maurer, N. J. (*Bermudez*)	*28.00*	26.00
Maurer, N. J. (*Mexican*)	22.00	19.00
Philadelphia (*Mexican*)	24.00	22.00
Kansas City, Mo. (*Texas*)	27.30	*22.30*
Los Angeles (*"D" grade, California*)	19 50†	13.50†
Birmingham (*Mexican*)	27.00	21.00
New Orleans (*Mexican*)	26.00	17.00

*In drums. †f.o.b. El Segundo Refinery.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade I)..	5-in. granite, 30 blocks per sq.yd.	**$147.00** per M.
San Francisco	Basalt block 4x7x8	70.00 per M.
Boston	5-in. granite 28 blocks per sq.yd.	132.00 per M.
Atlanta	Granite	2.50 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4x8x4	3.25 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	4x8x4	1.65 per sq.yd.
Kansas City	Granite	*3.85* per sq.yd.
Philadelphia	Granite	3.90@4.25 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft. wide	$0.24 per sq.ft.
	Manhattan, 4 ft. wide	.24 per sq ft.
	Queens, 5 ft. wide	.26 per sq ft.
	6x24-in. cross-walk	**1.30** per lin.ft.

CURBING—*New York:* Bluestone per lin.ft., f.o.b. barge New York, 5x16 in., 88c.; *St. Louis:* Class "A" straight, delivered, 5x18 in., $1.05 per lin.ft.; roundings, $1.60. *Birmingham:* Limestone, 5x18-in., $1.05 per lin. ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd
New York	3	16	**$2.40**
New York	3½	16	**2.70**
Boston	3½	18	**2.55**
Chicago	4	16	**2.25**
Chicago	3½	16	**2.10**
St. Louis	3½	16	**2.40**
St. Louis	4	16	2.70
Seattle	4	16	Off market
Minneapolis	3½	16	2.49
Atlanta	3½	16	2.00
New Orleans	3	16	2.20
New Orleans	3½	16	2.30
New Orleans	4	16	2.40
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	1.94
Detroit	4	16	....
Cincinnati	3½	16	*2.35*
Kansas City	4	16	*3.75*
Philadelphia	4	16	None used

Construction Materials

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	Sept. 3	One Year Ago	Sept. 3	One Year Ago	Sept. 4	One Year Ago
New York (*alongside dock*)..	$1.75	$1.75	$1.75	$1.75	$1.00	$1.00
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago	1.50	2.75	1.50	2.75	1.40	2.75
St. Louis	1.45	1.45	1.45	1.65†	1.18	1.18†
Seattle	1.50	1.50	1.50	1.50	1.50	1.50
Dallas	2.38	2.38	2.38	2.38	2.00	2.00
Minneapolis	1.65*	1.85*	1.65*	1.85*	1.25	1.25
Cincinnati	1.40†	1.40†	1.40†	1.40†	1.35†	1.35†
San Francisco	2.15	2.15	2.15	2.15	1.50	1.50
Boston	1.50†	1.40†	1.50†	1.40†	1.00†	1.00†
New Orleans	2.60	3.00	2.60	3.00	1.75	1.25
Los Angeles	0.85*†	0.75*†	0.85*†	0.85*†	0.50*†	1.20†
Atlanta	**2.20**	1.90†	**2.20**	1.90†	**1.65**†	1.40†
Detroit	2.02	2.02	2.02	2.02	1.62	1.62
Baltimore	1.40	1.40	1.60	1.60	0.70*†0.70*†	
Montreal	1.25†	1.25†	1.25†	1.50†	1.25†	1.25†
Birmingham	2.00	2.00	2.00	2.00	**1.50**	1.30†
Philadelphia	2.10	2.10	2.10	2.10	1.50	1.50
Kansas City (Joplin chats).	4.00	3.20†	4.00	3.20†	0.66*†	

New York—Grits, $1.75 per cu. yd.; ready mixed, **$1.90**.
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
*At pit. †Per ton.

CRUSHED STONE—Price for cargo or carload lots, f.o.b. city, is as follows per cu.yd.:

	1½ In.		¾ In.	
	Sept. 3	One Year Ago	Sept. 3	One Year Ago
New York	$1.75	$1.75	$1.85	$1.85
Chicago	**1.70**	2.75	**1.80**	2.75
St. Louis	1.83*	1.75*	1.83*	1.75*
Dallas	2.40	2.40	2.83	2.83
San Francisco	2.15	2.15	2.15	2.15
Boston	1.60*	1.45*	1.60*	1.40*
Minneapolis	1.75	1.75	1.75	1.75
Kansas City	1.50	1.50	1.50	1.50
Denver	2.50	3.50	2.50	3.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	**2.20***	2.00*	**2.20***	2.00*
Cincinnati	1.90*	1.90*	1.90*	1.90*
Los Angeles	1.00*	1.15	1.00*	1.00
Detroit	1.90*	1.70	1.90*	1.70
Baltimore	2.50	2.50	2.55	2.55
Montreal	1.80*	2.25*	1.90	2.25*
Philadelphia	2.10	2.10	2.10	2.10
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.25*	3.25*	3.25*
Birmingham	2.00	....	2.00	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plant

	1½-In.	2-In.	Roofing	Sand
Youngstown District	$1.25	$1.35	$2.00	$1.25
Steubenville District	1.25	1.30	2.00	1.30
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa	....	....	2.50	....
Birmingham, Ala	.80@.90	1.15	2.05	....
Buffalo, N. Y., and Erie, Pa	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.30	1.30	1.30	1.30
Eastern Pa. and Northern N. J.	1.25	1.25	2.50	1.25
Western Pennsylvania	1.25	1.25	2.50	1.25
Longdale and Glen Wilton, Va.	1.25	1.25	2.50	....
Toledo, Ohio	1.25	1.25	1.50	1.25

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$18.20	$12.00@$13.10	$3 50*	$2.25@2.75*
Chicago	20.00	18.00	1.45†	**1.45**†
St. Louis	23.00	19.00	**14.00**‡	**14.00**‡
Boston	*19.50*	*13.25@14.75*	3.75*	3.00*
Dallas	18.00	....	.....	1.85†
Cincinnati	16.60	14.30	.....	13.40‡
San Francisco	....	22.00	.....	1.60†
Minneapolis	25.50	21.00 (white)	1.60@1.70†	1.35†
Denver	24.00	.....	.....	2.70*
Detroit	12.40	12.40	.....	17.00‡
Seattle, *paper sacks*	24.00	....	2.80†	....
Los Angeles	25.00	18.00	3.50	19.50‡
Baltimore	24.25	17.85	2.55†	....
Montreal	....	21.00	....	*9.50*‡
Atlanta	22.50	14.00	*2.00*†	1.30†
New Orleans	24.00	16.00	2.50†	2.00*
Philadelphia	23.00	16.00	....	**1.92**†
Kansas City	*17.50*	*15.00*	**2.59***	**2.10***
Birmingham	22.50	15.00	2.10†	1.85†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, exclusive of bags:

	Aug. 6	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	**1.65**	1.50
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	**2.75**	2.50
St. Louis (Carney)	**2.35**	2.35
Birmingham (Magnolia) pozzolan cement	2.40	2.10

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b points listed *without bags*. Cash discount not deducted.

	Sept. 3	One Month Ago	One Year Ago
New York, del. by truck	$2.50@2.60	$2.50@2.60	$2.50@2.60
New York, alongside dock to dealers	2.15	2.15	2.15
Jersey City	2.33	2.33	2.33
Boston	*2.45*	2.45	2.64
Chicago	2.20	2.20	2.20
Pittsburgh	2.19	2.19	2.19
Cleveland	2.39	2.39	2.39
Detroit	2.35	2.35	2.40
Indianapolis	*2.39*	2.39	2.41
Milwaukee	2.35	2.35	2.35
Duluth	2.19	2.19	2.19
Peoria	2.37	2.37	2.37
Cedar Rapids	2.44	2.44	2.44
Davenport	2.39	2.39	2.39
St. Louis	2.30	2.30	2.30
San Francisco	2.31	2.31	2.61
New Orleans	2.40	2.40	2.40
Minneapolis	2.42	2.42	2.42
Denver	2.84	2.84	2.84
Seattle	2.65	2.65	2.90
Dallas	2.05	2.05	2.05
Atlanta	*2.25*	2.40	2.35
Cincinnati	2.47	2.47	2.47
Los Angeles	2.52	2.52	2.83
Baltimore	2.50	2.50	2.90
Birmingham	2.40	2.40	2.40
Kansas City, Mo.	**2.30**	2.30	2.70
Montreal	1.80	1.80	1.90
Philadelphia	2.41	2.41	2.41
St. Paul	2.42	2.42	2.42
Toledo	2.40	2.40	2.45

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.95	Hudson, N. Y.	$2.05
Universal, Pa.	1.95	Leeds, Ala.	1.95
Steelton, Minn.	2.00	Hannibal, Mo.	2.05
Fordwick, Va.	2.05	Lehigh Valley District	1.95
Mitchell, Ind.	2.05	Wyandotte, Mich.	2.10
Iola, Kan.	1.95	Alpena, Mich.	1.95
Mason City, Ia.	2.00	Richard City, Tenn.	2.05
La Salle, Ill.	2.05	Kingsport, Tenn.	2.05

E. N.-R. Prices of Construction Materials

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0.97	$1.01	$1.39	$1.06	$1.13	$1.22
049	28	1.23	1.29	1.76	1.35	1.38	1.55
068	35	1.51	1.58	2.16	1.66	1.67	1.91
093	45	1.94	2.03	2.77	2.13	2.00	2.46
126	57	2.39	2.51	3.45	2.63	2.55	3.03
153	68	2.86	2.99	4.11	3.14	3.15	.....
180	78	3.28	3.43	5.70	3.60	3.47	.....
245	103	4.33	4.53	6.21	4.75	4.58	.....
287	119	5.00	5.24	7.19	5.50	5.26	6.35
336	138	5.80	6.07	8.35	6.37	6.11	.....
395	160	6.72	7.04	9.65	7.38	7.12	.....
PAVING							
036P	17	$0.74	$0.77	$1.06	$0.81	$0.76	.....
053P	24	1.04	1.09	1.50	1.14	1.07	.....
072P	31	1.32	1.38	1.90	1.45	1.39	.....
097P	40	1.70	1.78	2.45	1.87	1.90	.....
049R	24	1.04	1.09	....	1.14	1.07	.....
067R	31	1.32	1.38	....	1.45	1.39	.....
089R	40	1.70	1.78	....	1.87	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq.ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted:

Weight in pounds	New York	Birmingham	St. Louis	San Francisco	Dallas
2.2	$19.00	$22.00	$21.00	$24.00	$23.50
2.5	20.50	23.00	23.00	26.00	25.00
3.0	23.50	26.00	27.00	30.00	28.50
3.4	25.00	28.00	29.00	33.00	31.00

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Warehouse, Uncut: Pittsburgh Mill	Birmingham	New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$1.90@2.00	$2.25	$3.24	$3.00	$3.15	$3.38	$3.35
⅝	2.00@2.10	2.35	3.34	3.10	3.25	3.43	3.45
¾	2.10@2.20	2.45	3.44	3.20	3.35	3.48	3.55
⅞	2.30@2.40	2.65	3.64	3.40	3.55	3.63	3.75
1	2.90@3.00	3.25	4.24	4.00	4.15	3.78	4.35

For size and cutting extras, see bar card of July 15, 1923.

ROLLED FROM RAILS

	St. Louis	Dallas		St. Louis	Dallas
½ and larger	$2.55	$2.80	½	$2.95	$3.02
⅝ in.	2.65	2.85	¾	3.55	3.50
⅞	2.75	2.90		.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Sept. 3	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	$17.50@18.00	$18@19	$17.00	$45.00	$51.00
New York (at dock)	14.50@15.00	15@16	.....	.....	.....
Chicago	12.00	12.00	12.00	42.00	45.00
St. Louis, salmon (del.)	16.00	16.00	16@18	37.50	40.00
Denver, salmon	12.00	12.00	12.00	.....	.....
Dallas	11.60	11.60	14.10	35.00	.....
San Francisco	15.50	15.50	15.50	.....	.....
Los Angeles	11.50	11.50	15.00	(not used)	
Boston (del.)	18.00	18.00	21.00	45.00	51.00
Minneapolis (del.)	13.50	13.50	14.00	.....	.....
Kansas City	16.50	14.50	16.50	(no market)	
Seattle	15.00	15.00	15.00	.....	42.50
Cincinnati	17.00	17.00	17.00	40.00	45.00
Montreal	17.50	17.50	17.50	100.00†	68.00
Detroit (del.)	16.00	16.00	17.50	37.50	40.50
Baltimore	17.00	18.00	18.00	40.00	45.00
Atlanta	10.50	10.50	11.00	40.00	.....
New Orleans	15.00	15.00	19.50	.....	.....
Birmingham	12.50	12.50	12.50	40.00	45.00
Philadelphia	19.00	19.00	19.00	40.00	50.00
Pittsburgh (del.)	16.00	16.00	16.00	.....	.....
Cleveland	14.00	14.00	16.00	.....	.....

*For paving blocks 3x8½x4 and 3½x8½x4 respectively. †Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Sept. 3 on Trucks*†	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco†	Perth Amboy N. J., Factory*
4x12x12	$0.1162	$0.1162	$0.075	$0.12	$0.07	$0.108	.....
6x12x12	.1743	.1743	.096	.....	.095	.156	.....
8x12x12	.2179	.2179	.135	.22	.132	.244	.....
10x12x12	.....	.....	.167	.....	.165	.....	$0.252
12x12x12	.....	.....	.215	.....	.195	.....	.312

*5 per cent off for cash. †Partition tile.

	4x12x12	8x12x12	12x12x12
Boston	$0.0875	$0.1725	.....
Minneapolis (f.o.b. cars)	.0636	.106	$0.189
Minneapolis (delivered)	.07	.116	.205
Cincinnati	.07485	.13745	.....
Kansas City	.085	.145	.....
Denver	.085	.155	.188
Seattle (delivered)	.10	.20	.30
Los Angeles	.085	.172	.....
New Orleans	.13	.20	.....
Detroit (delivered)	.0775	.1743	.....
Montreal	.20	.225	.30
Baltimore	.125	.27	.....
Atlanta	.0893	.1674	.....
Dallas	.10	.19	.275
Birmingham	.11	.1824	.22
Pittsburgh (delivered)	.068	.128	.179
Cleveland	.07	.149	.....

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at place named:

	Pittsburgh Mill	Birmingham	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$1.90@2.00	$2.05	$3.34	$4.15	$3.25	$3.10	$3.30
Channels, 3 to 15 in.	1.90@2.00	2.10	3.34	4.15	3.25	3.10	3.30
Angles, 3 to 16 in., ¼ in. thick	1.90@2.00	2.10	3.34	4.15	3.25	3.10	3.30
Tees, 3 in. and larger	1.90@2.00	2.10	3.34	4.15	3.35	3.10	3.30
Plates, ¼ in. thick and heavier	1.80@1.90	2.00	3.34	4.15	3.25	3.10	3.30

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York Sept. 3	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in.	$2.40@2.50	$4.50	$3.75	$3.50	$3.65	$5.00	$4.75
CONE HEAD BOILER							
½ in.	$2.70@2.90	$4.70	$3.85	$3.70	$4.20	$5.20	$5.00
⅝ and ¾	2.85@3.05	4.85	4.01	3.80	4.45	5.35	5.15
⅞ and 1	3.10@3.30	5.10	4.25	4.05	4.60	5.60	5.50

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Birmingham	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.65	$2.85	$3.15	$3.50	$4.20	$2.90	4.95
Cut	2.90	2.90	....	5.00	5.00	3.30	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	Black	Seattle Black
½	$7.50	$5.75	$7.75
⅝	7.05	5.30	5.65
¾	6.90	5.15	5.50

Pittsburgh base in lots of 200 kegs or more, $3.25.

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs **$3.00** per roll to consumers in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost **$8.64** per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., $5.80 per square.

ROOFING MATERIALS—Prices f.o.b. New York, to consumers in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton	**$95.25**
Tar pitch (in 400-lb. bbl.), per 100 lb.	**2.09**
Asphalt roofing (in barrels), per ton, f.o.b. plant	**2.03**
Asphalt felt (light), per ton, f.o.b. plant	**99.90**
Asphalt felt (heavy), per ton, f.o.b. plant	**99.90**

Delivered in Metropolitan Dist., $2.00 additional.

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 82 per cent; "A," 87 per cent; "B," 88 per cent. Double thickness "AA," 82 per cent; "A," 88 per cent; "B," 89 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.30@2.40	$3.60	$3.50	$3.70	$3.89
No. 12	2.35@2.45	3.65	3.55	3.75	3.94
No. 14	2.40@2.50	3.70	3.60	3.80	3.99
No. 16	2.50@2.60	3.80	3.70	3.90	4.09
Black					
*Nos. 17 to 21	2.95@3.00	4.30	3.80	4.45	4.15
*Nos. 22 to 24	3.00@3.05	4.35	3.85	4.50	4.20
*No. 26	3.05@3.10	4.40	3.90	4.55	4.25
*No. 28	3.15@3.20	4.50	4.00	4.65	4.35
Galvanized					
No. 10 and 11	3.20@3.30	4.50	4.00	4.75	4.35
No. 12 to 14	3.30@3.40	4.60	4.10	4.85	4.45
No. 16	3.45@3.55	....		5.00	4.60
Nos. 17 to 21	3.60@3.70	4.90	4.40	5.15	4.75
Nos. 22 to 24	3.75@3.85	5.05	4.55	5.30	4.90
*Nos. 25 and 26	3.90@4.00	5.20	4.70	5.45	5.05
*No. 28	4.20@4.30	5.50	5.00	5.75	5.35

* For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Sept. 3	One Year Ago	Chicago: Sept. 3	One Year Ago
Raw in barrels (5 bbl. lots)	**$1.08**	$1.07	**$1.08**	$1.05

E. N.-R. Prices of Construction Materials

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry		In Oil	
	Sept. 3	1 Yr. Ago	Sept. 3	1 Yr. Ago
Red	$15.75	$14.75	$17.25	$16.25
White	15.75	14.75	15.75	14.75

Lumber

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$26.00	$27.00	$28.00	$31.00
3x6 and 8	26.00	27.00	28.00	31.00
4x4-6 and 8	26.00	27.00	28.00	31.00
3x10 and 12	26.00	27.00	28.00	31.00
3x14	30.00	30.00	32.00	34.00
4x10 and 12	26.00	27.00	28.00	31.00
4x14	30.00	30.00	32.00	34.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$28.00	$30.00	$32.00
6x14	34.00	36.00	38.00
8x10	28.00	30.00	32.00
8x14	34.00	36.00	38.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	$45.00	$46.00	$38.00	$39.00
3x10 to 10x10	49.00	50.00	41.00	42.00
3x12 to 12x12	54.00	55.00	45.00	46.00
3x14 to 14x14	62.00	63.00	51.00	52.00
3x16 to 16x16	*69.00*	*70.00*	44.00	45.00
3x18 to 18x18	.....	.....	46.50	47.50
4x20 to 20x20	.....	.....	50.50	51.50

* Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under; for sizes over 12x12 add $2; for merchantable add $2 to sizes 10x10 and under.

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	$51.00	$48.00†	$50.00	$50.00	$60.00	$58.00†
Seattle		30.50	.....	.....		24.00
New Orleans	45.00	.....	.....	.....	35.00	.....
Baltimore	32.50	49.25	53.00	60.00	38.00	49.75
Cincinnati	37.00	73.00	73.00	85.00	48.00	77.00
Montreal	50.00	58.00	.....	.....	60.00	65.00
Los Angeles	.....	40.00	.....	.....	.....	40.00
Denver	.....	*32.25*	*32.25*	.....	.....	*33.75*
Minneapolis	43.00	38.75	35.00	.....	44.50	38.75
Atlanta	31.00	.....	.....	.....	34.00	.....
Dallas	56.00	.....	.....	.....	58.50	.....
Kansas City, Mo.	42.50	40.75	.....	.....	53.50	41.75
Birmingham	32.00	.....	.....	.....	34.00	.....
Philadelphia	54.00	34.00	37.00	40.00	62.00	34.00
Detroit	44.75	50.75	.....	.....	54.75	50.75
St. Louis	40.00	.....	.....	.....	50.00	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	$46.00	$42.00†	$44.00	$51.00	$48.00†
Seattle		26.00	.....	.....	30.00
New Orleans	83.00	.....	.....	43.00	.....
Baltimore	55.00	44.00	44.00	34.00	50.00
Cincinnati	70.00	79.00	75.00	38.00	85.00
Montreal	56.00	50.00	45.00	45.00	45.00
Los Angeles	.....	35.00	.....	.....	95.00
Denver	.....	*29.25*	*29.25*	.....	*30.25*
Minneapolis	43.00	38.75	34.75	38.00	36.25
Atlanta	18.00	.....	.....	28.00	.....
Dallas	52.00	.....	.....	56.00	.....
Kansas City, Mo.	*50.25*	40.25	.....	42.25	37.25
Birmingham	.....	.....	.....	.....	.....
Philadelphia	32.00	33.00	36.00	54.00	34.00
Detroit	37.25	37.50	.....	44.00	41.75
St. Louis	*42.00*	.....	.....	*29.50*	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M. ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers price to contractors on large projects.
St. Louis—Wholesale price to contractors, f.o.b. cars, $2 per M.ft. additional.
Seattle—Price to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M.ft. additional.
*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

Miscellaneous

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Sept. 3	One Month Ago	One Year Ago
$2.25@$2.30	$2.25@$2.30	$2.05@2.15

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft.; ½-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ½-in. and larger, in 1200-ft. coils:

Boston	$0.19@.23	New Orleans	$0.24½
New York	.27	Los Angeles	.24½
Chicago	.24	Seattle	.24
Minneapolis	.26½	St. Louis	.24½
San Francisco	.24	Montreal	.16
Atlanta	.33	Detroit	.26
Denver	.28	Baltimore	.18
Cincinnati	.21	Kansas City	.20½
Dallas	.31	Birmingham	.23@.25
Philadelphia	.26		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.225	.25
Kansas City	.2125	.2325
Seattle	.165	.19
Chicago	.22	.245
Minneapolis	.1917	.2123
St. Louis	.22	.245
Denver	.2025	.2275
Dallas	.225	.302
Los Angeles	.1875	.2125
Atlanta	.23	.255
Baltimore	.22	.23
Cincinnati	.22	.245
Montreal	.195	.235
Birmingham	.23	.255
New Orleans	.233	.26
San Francisco	.1625	.1925
Philadelphia	.215	.24

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f.o.b. works:

Sulphate of aluminum, in bags, per 100 lb	$1.40@1.45
Sulphate of copper, in bbl., per 100 lb	4.50@4.60
Soda ash, 58%, in bags, per 100 lb	1.25
Chlorine, liquid, tanks, per lb	.04@.04½
Hypochlorite of lime (bleaching powder) in drums, per 100 lb	1.90@2.00

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.735
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15*
Chicago	.34	Philadelphia	.32
Cincinnati	.29	St. Louis	.43
Cleveland	.19	St. Paul	.60
Denver	1.15*		

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.